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Introduction

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3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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National Aeronautics and Space Administration

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

May 23, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-17876* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

Quarterly Progress Report No. 72 [for Period Ending Nov. 30, 1963] [A REVIEW OF THE RESEARCH ACTIVITIES ON RADIO PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING]

H. J. Zimmermann and G. G. Harvey 15 Jan. 1964 329 p refs (NASA Grant NsG-496; Contract DA-36-039-SC-78108; Contract AT(30-1)-1842; Contract AF 19(604)-5992; NSF Grant G-16526 et al)

(AD-431661)

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N64-17883* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

LINGUISTICS

R. Jakobson, A. N. Chomsky, M. Halle, J. A. Fodor, J. J. Katz et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 215–221 refs (See N64-17876 10-01)

(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03; Contract AF 19(628)-2487)

Work in progress deals with specific problems in phonology, morphology, syntax, language learning and language disturbances, linguistic change, semantics, as well as with the logical foundations of the general theory of language. Several studies are parts of complete linguistic descriptions of particular languages (English, Russian, and Siouan). R.T.K.

N64-18012 Aerospace Corp., El Segundo, Calif.
BIBLIOGRAPHY ON THE USE OF REDUNDANCY AS A MEANS OF IMPROVING RELIABILITY
J. G. Mead and R. J. Thompson 15 Jan. 1964 32 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-375; TDR-269(4303)-6; AD-433614)

This bibliography was compiled as part of a series of cost effectiveness studies on the optimum allocation of redundancy. The cutoff date of the listed documents is approximately December 1963. Author

N64-18091 Joint Publications Research Service, Washington, D.C.
HIGH-TEMPERATURE LUBRICATION AND INORGANIC SOLID SUBSTANCES
Ch'en Shao-li and Ou-yang Chin-lin *In* "Transl. on Communist China's Sci. and Tech., no. 76" 26 Mar. 1964 p 19-25 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 12, 1963 p 59-61
(JPRS-23893; OTS-64-21906) OTS: $1.00

A brief report is presented of investigations of the friction-temperature characteristics of various types of inorganic solid powders. The substances included high-melting-point metal oxides, sulfides, salts (inorganic and organic), silicates, graphite, and carbon black. The test results indicate that the selection of multimixture inorganic solid substances is one hopeful means of maintaining low friction and high resistance against wear for high-temperature solid lubricants of wide temperature ranges. P.V.E.

N64-18102* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-25, VOLUME IV, FOR THE PERIOD DECEMBER 1, 1963 TO JANUARY 31, 1964. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
29 Feb. 1964 275 p refs
(NASA Contract NAS7-100)
(NASA CR-53456; JPL-SPS-37-25, Vol. 4) OTS: $17.50 ph

Research activities in the following areas are summarized: (1) systems division—a summary of the trajectory analysis and propulsion requirements for advanced propulsion spacecraft, application of the method of averages to celestial mechanics; (2) guidance and control division—flight computers and sequencers, electrical conversion; (3) engineering mechanics division—materials and engineering research; (4) engineering facilities division—wind tunnels, hypervelocity laboratory; (5) propulsion division—polymer research, advanced propulsion engineering; (6) telecommunications division—optical communications components, coding theory; and (7) space sciences division—space instruments development, infrared induced absorption of dilute solutions of H_2 and D_2 in liquid argon, and a simplified operational method for derivation of the plasma kinetic equation. P.V.E.

N64-18183 Air Force Systems Command, Wright-Patterson AFB, Ohio Flight Dynamics Lab.
THE AIR FORCE WEAPON SYSTEM ENVIRONMENTAL PROGRAM
R. K. Hankey Mar. 1964 10 p
(FDL-TDR-64-20; AD-433882)

The solution to the environmental problems encountered during weapon system development requires that a systematic and timely environmental program be accomplished on each weapon system developed, that environmental research be increased, and that the data evolving from research and weapon system environmental programs be collected, analyzed, and made widely available. This report gives a general description of the Air Force weapon system environmental program and indicates areas requiring increased research efforts. Author

N64-18226* Sperry Gyroscope Co., Great Neck, N.Y.
MINIMUM VARIANCE ORBIT DETERMINATION PROGRAM First Quarterly Status Report, 22 Jul.-22 Oct. 1963
8 Nov. 1963 148 p refs
(NASA Contract NAS5-3509)
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15. PROPAGATION CORRECTION A. Cristina p 131-147 refs (See N64-18240 10-80)

N64-18251 Hudson Inst., Inc., Harmon-on-Hudson, N.Y.
STUDY FOR HYPOTHETICAL NARRATIVES FOR USE IN COMMAND AND CONTROL SYSTEMS PLANNING. VOLUME I: PROFILES OF THE FUTURE Final Report [1 Sep. 1962-31 Aug. 1963]

William Pfaff and Edmund Stillman, ed. L. G. Hanscom Field, Mass., Electron. Systems Div., Sep. 1963 157 p
(Contract AF 19(628)-1676)
(HI-285-RR, Vol. 1; ESD-TDR-64-178, Vol. 1; AD-434500)

The report contains: (1) 23 "Future Worlds," or total environments, designed for use as scenario contexts; (2) 40 detailed "Alternate Area Projections," for the Soviet Union, Western Europe, China, Japan, South Asia, Middle East and North Africa, Southeast Asia, Latin America, and Sub-Saharan Africa, designed as war-gaming constraints and usable in an extensive series of combinations; (3) the "Extended Area Projection," a systematic method for deriving the possible detailed character of future diplomatic and strategic actors, in this case the U.S.S.R. for 1965, 1970, and 1975; and (4) the "Alternative National Policy Card Deck," a propaedeutic device for devising possible United States policies to interact with the environments generated by methods (1), (2), and (3) above. Finally, an extended scenario involving the causation, initiation, and course of a series of subwars escalating to a nuclear exchange between the United States and Soviet Union, derived by method (2), is presented in toto as Volume III of this report. Author

N64-18252 Hudson Inst., Inc., Harmon-on-Hudson, N.Y.
STUDY FOR HYPOTHETICAL NARRATIVES FOR USE IN COMMAND AND CONTROL SYSTEMS PLANNING. VOLUME II: THE ALTERNATIVE NATIONAL POLICY CARD DECK Final Report [1 Sep. 1962-31 Aug. 1963]
William Pfaff and Herman Kahn, ed. L. G. Hanscom Field, Mass., Electron. Systems Div., Sep. 1963 112 p For abstract see N64-18251 10-01
(Contract AF 19(628)-1676)
(HI-285-RR, Vol. 2; ESD-TDR-64-178, Vol. 2; AD-434798)

N64-18253 Hudson Inst., Inc., Harmon-on-Hudson, N.Y.
STUDY FOR HYPOTHETICAL NARRATIVES FOR USE IN COMMAND AND CONTROL SYSTEMS PLANNING. VOLUME III: GAME TRANSCRIPT AND COMMAND AND CONTROL ANALYSIS Final Report [1 Sep. 1962-30 Aug. 1963]
William Pfaff and Edmund Stillman, ed. L. G. Hanscom Field, Mass., Electron. Systems Div., Sep. 1963 163 p For abstract see N64-18251 10-01
(Contract AF 10(628)-1676)
(HI-285-RR, Vol. 3; ESD-TDR-64-178, Vol. 3; AD-435038)

N64-18420 Aeronautical Research Labs., Melbourne (Australia) Dept. of Supply
ANNUAL REPORT 1962-63
1963 44 p refs

The topics discussed include: (1) aerodynamics—applied aerodynamics, industrial aerodynamics, theoretical fluid mechanics, hypersonic aerodynamics; (2) structures—fatigue research, aeronautical turbulence, vibrations and aeroelasticity; solid mechanics, strain gaging; (3) properties of metal and alloys; (4) mechanical engineering—engine design and development, combustion research, research related to the supersonic engine; (5) guided weapons—antisubmarine weapon development, weapon guidance; (6) aircraft operation—temperatures in parked aircraft, human engineering; and (7) service groups—engineering facilities, instrumentation, mathematical services, scientific photography. R.T.K.

N64-18450* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A TECHNIQUE FOR ESTIMATING FUNDING AND MANPOWER REQUIREMENTS FOR RESEARCH AND DEVELOPMENT LONG-RANGE PLANNING
Frank E. Goddard, Jr., William H. Bayley, David K. Carlisle, James R. Edberg, and Fred H. Felberg 8 Nov. 1962 19 p
(NASA Contract NAS7-100)
(NASA CR-53571; JPL Planning Rept. 35-6 (Rev. 1)) OTS: $1.60 ph

This report outlines the technique that has evolved from a study of the long-range programing problem. The material is extracted from an internal planning report and is presented only as one method by which estimates of resource requirements can be made. Charts and figures required to understand the technique are presented, together with a simplified step-by-step procedural example showing how estimated requirements are determined for a given project that, in itself, is a component part of a program and of the overall installation effort. Author

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-17991* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF SPANWISE VARIATION OF LEADING-EDGE SWEEP ON THE LIFT, DRAG, AND PITCHING MOMENT OF A WING-BODY COMBINATION AT MACH NUMBERS FROM 0.7 TO 2.94
Raymond M. Hicks and Edward J. Hopkins Washington, NASA, Apr. 1964 56 p refs
(NASA TN D-2236) OTS: $1.50

Lift, drag, and pitching-moment characteristics of four wing–body combinations are presented. Results of this investigation are presented throughout a Mach number range from 0.7 to 2.94 at a constant unit Reynolds number of 2.5 million per foot. Experimental forces and moments are compared with the predicted values for the planforms with straight leading edges. The maximum lift–drag ratios of the various wings are compared on the basis of an all-turbulent boundary layer and zero leading-edge thickness throughout the Mach number range. Sublimation pictures were used to adjust the basic data to the condition corresponding to an all-turbulent boundary layer. At all supersonic Mach numbers above 1.4, the ogee planform had the highest maximum lift–drag ratio, but at subsonic Mach numbers the modified trapezoidal planform had the highest aerodynamic efficiency. The nonlinear variation of pitching moment with lift exhibited by the trapezoidal planform at transonic Mach numbers did not occur for the modified trapezoidal planform. Author

N64-18076 General Electric Co., Philadelphia, Pa. Missile and Space Div.
HIGH VELOCITY RATIO NEAR FREE MOLECULAR FLOW PAST A NARROW STRIP
J. Enoch (Kansas U.) and N. Macri Oct. 1963 39 p refs
(Contract AF 04(647)-617; Contract AF 04(694)-222)
(R63SD81; AD-433233)

The problem of high velocity ratio near free molecular flow past a narrow strip is studied from the point of view of a previously developed kinetic model. The finite strip problem is approximated by the infinite strip problem. The logarithmic divergences arising in the infinite strip problem are handled

by means of a cutoff procedure, which is discussed in detail. Extensive numerical calculations of all the relevant aerodynamic quantities are presented. Author

N64-18154 Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS OF AERODYNAMIC HEATING ON A 15° CONE OF GRADED WALL THICKNESS AT A MACH NUMBER OF 6.8
J. G. Woodley London, HMSO, 1964 29 p refs
(ARC-R&M-3357; supersedes RAE-TN-AERO-2847, ARC-24447) HMSO: 11s 6d

This report describes transient wall temperature measurements made on a 15° total-angle cone at zero incidence in an airstream of Mach number 6.8. The skin of the model was sufficiently thin to allow it to reach zero-heat-transfer conditions within a running time of one minute. In order to reduce effects of longitudinal heat conduction during a run the electroformed nickel skin of the model was made with graded thickness, and, as a result, fairly uniform temperature distributions along the surface were obtained at all times in both the laminar and turbulent regions. Values of heat transfer, calculated from the wall temperature–time histories using the thin-wall "heat pulse" assumption, together with recovery temperature are compared to theoretical estimates using the intermediate enthalpy method. Author

N64-18188 Lincoln Lab., Mass. Inst. of Tech., Lexington
NEWTONIAN DRAG OF COATED CYLINDERS
Aubyn Freed 7 Jan. 1963 19 p refs
(Contract AF 19(628)-500)
(Rept. 22G-13; AD-434094)

Newtonian impact theory is used to examine the variation in ballistic coefficient of a coated cylinder as the thickness of the coating decreases. It is shown that when the density of the coating is less than one-half that of the core material, an initial value of coating thickness can be chosen that results in a steady increase of the ballistic coefficient as the thickness of the coating approaches zero. The largest such value of coating thickness, the corresponding minimum value for the ballistic coefficient, and the rate at which the ballistic coefficient rises to that of the bare core are shown to be simple functions of the particular density ratio. Author

N64-18358 General Dynamics/Astronautics, San Diego, Calif.
EXPERIMENTAL AND THEORETICAL STUDIES OF UNDEREXPANDED JETS NEAR THE MACH DISC
L. D'Attorre and F. Harshbarger 19 Feb. 1964 58 p refs
(Contract AF 19(628)-3269; ARPA Order 363, Amendment 3)
(GDA-DBE-64-008; AD-434015)

A procedure is given for calculating the axial position and the size of the Mach disc and for calculating the mixed flow problem downstream of the Mach disc in underexpanded, inviscid jets. The incident flow must be known. The location of the Mach disc is selected, by trial and error, at a position along the convergent shock for which the usual triple-point conditions are satisfied and for which the flow is locally normal to the Mach disc. Experimental results are presented for a small number of cases of typical conditions ranging from hot to cold flow, from a quiescent ambient to a supersonic ambient, and for exit to ambient pressure ratios from 4 to 35. In addition, schlieren photos are presented for a typical Mach disc generated by a semibell nozzle contour. In this case the extent of the subsonic region behind the Mach disc is determined also. Author

N64-18482 Tokyo U. (Japan) Aeronautical Research Inst.
STUDY OF ROW OF CIRCULAR CYLINDERS IN SUPERSONIC AND HYPERSONIC FLOW 3. DRAG OF ROW OF PARALLEL CIRCULAR CYLINDERS IN SUPERSONIC FLOW
Ryuma Kawamura, Takashi Sawada, and Kazuichi Seki Dec. 1963 40 p refs ENGLISH summary
(*Its* Bull. v. 3, no. 8)

A wind-tunnel investigation is presented of the drag of a row of parallel cylinders placed in a Mach 2 supersonic flow. The number of cylinders tested in one row is two, three, and five, respectively. The length and diameter of each cylinder are 110 mm and 12 mm, respectively, and the Reynolds number referred to the diameter is 3×10^5. The drag of each cylinder is measured separately by use of a strain wire gage. Results show that the mean drag coefficient of the rows with the same distance between cylinders increases as the number of cylinders increase. The three-dimensional shape of the bow shock wave is fairly well determined by combining schlieren photographs taken vertically and horizontally, from which it is possible to evaluate the shock drag due to bow shock. In the case of a two-cylinder row, the bow shock drag coefficient increases slowly from 0.72 to 0.75 as the distance between cylinders varies from zero to 30 mm. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see:* 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-18332 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
MODIFICATION OF MULTHOPP'S LIFTING SURFACE THEORY WITH A VIEW TO AUTOMATIC COMPUTATION
E. van Speigel and J. G. Wouters 6 Jun. 1962 22 p refs
(Supported by the Netherlands Inst. voor Vliegtuigontwikkeling)
(NLR-TN W.2)

An approximate method for the calculation of the aerodynamic forces on a wing of arbitrary planform in a subsonic nonviscous flow has been given. This method can be considered as a modification of Multhopp's lifting-surface theory with the view on the application of digital computers. Numerical results are given for a sweptback wing and the circular wing. Author

N64-18390 Rensselaer Polytechnic Inst., Troy, N.Y.
A NEW METHOD OF BOUNDARY LAYER CONTROL
Mark H. Siegel Feb. 1964 10 p refs
(TR AE-6403)

The suggested system for boundary-layer control utilizes a flow of ram air as the driving stream of a flow inducer without mechanical parts. The inducer sucks away low-energy boundary-layer air, thus preventing flow separation. An airfoil employing this system might be constructed as follows. Numerous small holes are incorporated at the proper inclination on the aft portion of the upper surface. Spring-loaded inlet louver doors are positioned on the forward portion of the surface of the airfoil and are made to open inward under a given minimum-pressure difference. The inlet louvers are connected to the upper

surface by internal ducting, which also serves to channel the flow into an exhaust. P.V.E.

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-18043 Princeton U., N.J.
THE GENERAL CHARACTERISTICS OF WINGED GROUND EFFECT MACHINES
Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1963 148 p refs
(Contract DA-44-177-TC-833)
(TRECOM-TR-63-36; Rept. 657; AD-426788)

The purpose of the research was to determine the performance and stability advantages that could be obtained by the addition of wings to a ground effect machine. The work is both theoretical and experimental, the latter being accomplished both with models and a winged version of the full-scale Curtiss–Wright Air Car. Results indicate that substantial gains in both performance and stability are attainable by such a hybrid machine when compared to the pure GEM. It is generally concluded that for the high-speed cruise condition wings will be found most beneficial if the base loading of the craft is not excessive. Author

N64-18326 Aeronautical Research Council (Gt. Brit.)
DYNAMICS OF THE DEFORMABLE AEROPLANE. PART I: THE EQUATIONS OF MOTION. PART II: A STUDY OF THE TRIM STATE AND LONGITUDINAL STABILITY OF THE SLENDER INTEGRATED AEROPLANE CONFIGURATION
R. D. Milne (London U.) London, HMSO, 1964 64 p refs
(ARC-R&M-3345; supersedes ARC-24060) HMSO: £ 15s

An integrated analytical treatment is presented that deals with the equilibrium and stability of the flexible airplane in flight. The analysis embodies those methods currently employed to investigate the behavior of the flexible airplane stemming, on the one hand, from the stability theory of the rigid airplane and, on the other, from conventional aeroelastic studies. The integrated treatment serves to clarify the regions of application of these restricted methods. The equations of motion for a flexible airplane are developed in as general a manner as possible. The general analysis is applied to a detailed study of the equilibrium and stability of the slender, integrated airplane configuration. Author

N64-18465 Aviation Safety Engineering and Research, Phoenix, Ariz.
CH-21A HELICOPTER AIRFRAME DEFORMATION UNDER A DYNAMIC CRASH CONDITION
William H. Reed and Donald F. Carroll Ft. Eustis, Va., Army Transportation Res. Command, Jan. 1964 48 p refs
(Contract DA-44-177-AMC-888(T))
(AvSER-63-3; TRECOM-TR-63-77; AD-433683)

This report presents a compilation of observations of airframe deformation that occurred during a full-scale droned crash of a CH-21A helicopter. The information contained in this report, though general in nature, is intended to convey an understanding of the type and severity of damage, which can be expected to occur in a moderately severe accident involving a CH-21A helicopter. The report contains verbal descriptions of the crash sequence and the airframe deformations that resulted, as well as photographs of typical component damage. Author

N64-18505 Advisory Group for Aeronautical Research and Development, Paris (France)
COMMENTS ON AGARD REPORT 408 BY THE V/STOL HANDLING QUALITIES TECHNICAL ASSISTANCE PANEL
John P. Reeder et al Jan. 1964 28 p Presented at the 23d AGARD Flight Mech. Panel Meeting, Athens, 8–9 Jul. 1963

Concurrent with the 23rd AGARD Flight Mechanics Panel Meeting, a Technical Assistance Group, comprised of specialists on V/STOL aircraft and aircraft-handling qualities, met in Athens on July 8 and 9, 1963, to discuss AGARD Report 408 "Recommendations on V/STOL Handling Qualities." Generally, report 408 was regarded as an excellent attempt to provide comprehensive handling criteria for the class of aircraft considered. However, several criticisms were offered; these fall into two categories—the first, of a general nature, concerned with the scope of the report, and the other directly connected with specific recommendations. The present draft is an attempt to present, in an organized manner, all the comments made. Added to the draft, as appendices, are the "Report of the Chairman to the Flight Mechanics Panel" as well as a summary by the Chairman and the Secretary of the V/STOL Handling Qualities Working Group. R.T.K.

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-17877* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RADIO ASTRONOMY
A. H. Barrett, J. W. Graham, R. P. Rafuse, W. C. Schwab, R. J. Allen et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 25–30 refs (See N64-17876 10-01)
(NASA Grant NsG-250-62; NASA Grant NsG-419; Contract Nonr-3963(02); Contract AF 19(628)-500)

Work has progressed in the following areas: (1) development of techniques for radiometry at millimeter wavelengths; (2) observation of extraterrestrial radio sources, principally, but not exclusively, at short centimeter and millimeter wavelengths; (3) microwave studies of the terrestrial atmosphere and surface with application to meteorological satellites; and (4) a study of wide base-line interferometry at millimeter wavelengths. R.T.K.

N64-18111* General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
CADMIUM ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER

R. A. Schmitt, R. H. Smith and D. A. Olehy Oxford, N.Y. Pergamon Press, Ltd. Repr. from Geochim Cosmochim. Acta, v. 27, 1963 p 1077–1088 refs
(NASA Contract NASw-579)

Abundances of cadmium have been determined by neutron-activation analysis in 31 meteorites: 0.52 to 1.16 ppm in five carbonaceous chondrites; 0.015 to 0.12 ppm in six ordinary bronzitic and hypersthenic chondrites; 0.042 to 3.3 ppm in three enstatitic chondrites; 0.022 and 0.065 ppm in two eucritic achondrites; 0.18 and 1.79 ppm in two nakhlitic achondrites; ≤ 0.010 and 0.33 ppm in two calcium-poor achondrites; < 0.004 and 0.056 ppm in two mesosiderites; 0.13 and 0.33 ppm in two pallasites; 0.0085 to 0.056 ppm in seven iron meteorites. An atomic abundance of Cd/10^6 Si atoms of 1.8 ± 0.6 is calculated for five carbonaceous chondrites, which agrees well with the solar value of 1.5 given by Aller. Cadmium abundances in two terrestrial basalts were 0.33 and 0.5 ppm and 0.026 and 0.24 ppm in two deepseated eclogites. Abundances of cadmium and other chalcophilic elements are discussed in terms of chondritic parent models. Author

N64-18146 RAND Corp., Santa Monica, Calif.
ON GEOMETRIC AND PHYSICAL METHODS FOR DETERMINATION OF THE PARALLAX OF THE SUN [O GEOMETRICKYCH A FYSIKALNICH METHODACH K URČENI PARALLAXY SLUNEČNI]
Karel Vodicka Jun. 1963 150 p refs Transl. into ENGLISH from Casopis Pest. Matematiky a Fiziky, 1911 p 195–213, 305–318, 473–484, 585–590; 1912 p 69–74, 192–203, 583–596; 1913 43–58, 183–201
(LT-61-99)

Geometric and physical methods for determining the parallax of the Sun are reviewed. Gill's method, which determines the solar parallax from the parallax of Mars, appears to be the most accurate of the various geometric methods discussed. The most accurate physical method appears to be based upon solving all of the conditional functional equations at one time, in such a manner that, upon using the method of least squares, the most probable values of the constants involved can be determined. I.v.L.

N64-18169* Northeastern U., Boston, Mass.
Semi-annual Status Report, Mar. 15, 1963-Sep. 15, 1963 [STUDIES IN MAGNETOHYDRODYNAMICS TO EXPLAIN THE STRUCTURE OF SPIRAL GALAXIES]
H. D. Greyber [1963] 3 p
(NASA Grant NsG-310-63)
(NASA CR-53468) OTS: $1.10 ph

A discussion is presented on the problem of the radiation that should be expected in the various frequency ranges from the galactic dipole magnetic field model. Calculations were performed on the cyclotron radiation to be expected from non-relativistic electrons in the dipole magnetic field of a spiral galaxy. A power spectrum was derived and estimates made for a typical galaxy (such as the Milky Way). The results of the calculations predict a radio source like Sagittarius A in the vicinity of the galactic center, but attaining a maximum somewhere in the frequency range from 10 kcs to 1 mcs. The radiation to be expected from the relativistic electrons in the dipole magnetic field and from the electrons in the current loop is being investigated. P.V.E.

N64-18200 Hamburger Sternwarte (W. Germany)
BRIGHTNESS AND STRUCTURE OF THE NA-EMISSION IN COMETS, THE HEADS OF COMETS AND THE LIFETIMES OF THEIR MOLECULES Technical Note No. 2
K. Wurm 1 Aug. 1963 34 p refs
(Contract AF 61(052)-583)
(AFCRL-64-82; AD-433778)

The structure of an Na coma of a comet is investigated. In consequence of a relatively high repulsive force originating from light pressure and a relatively high average lifetime of the atoms, a typical parabolic shape of this coma, which is in accord with observation, should be expected. From the extension and spherical shape of the CN– and C_2– heads in comets, an average lifetime of these molecules (until ionization takes place) of the order 10^6 sec at a unit heliocentric distance is derived. This long lifetime excludes densities of protons in the "solar wind," which exceed $np = 10\ cm^{-3}$. Author

N64-18217* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
APPLICATION OF THE METHOD OF AVERAGES TO CELESTIAL MECHANICS
J. Lorell, J. D. Anderson, and H. Lass 16 Mar. 1964 34 p refs
(NASA Contract NAS7-100)
(NASA CR-53530; JPL-TR-32-482) OTS: $3.60 ph

Formulas are derived giving the second-order secular and long-period effects on the orbit of the satellite of an oblate planet. The presentation is in terms of the standard osculating elements and their averages. The derivation involves the second-order method of averages for solving nonlinear differential equations. In the application to the present problem, this second-order theory can be very cumbersome. However, by introducing an auxiliary function, ψ, it has been possible to simplify the equations to a manageable form. Author

N64-18281 Library of Congress, Washington, D.C. Aerospace Information Div.
CATALOG OF PHOTOGRAPHIC, PHOTOVISUAL, AND PHOTORED MAGNITUDES OF 22,000 STARS
V. I. Voroshilov et al 25 Apr. 1963 14 p refs Transl. into ENGLISH from the publication "Katalog Fotograficheskikh, Fotovizual'nykh i Fotokrasnykh Velichin 22,000 Zvezd" Kiev, Izd. AN USSR, 1962 173 p
(AID-T-63-51; AD-403682) OTS: $1.60 ph

This catalog contains photographic, photovisual, and photored magnitudes of stars in the areas of the constellations of Aquila, Hercules, and Cygnus in the Milky Way. Nearly all stars brighter than photographic magnitude 13.5 are included. I.v.L.

N64-18322* General Dynamics Corp., San Diego, Calif. General Atomics Div.
RARE-EARTH, YTTRIUM AND SCANDIUM ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER – II
R. A. Schmitt, R. H. Smith, and D. A. Olehy Repr. from Geochim. Cosmochim. Acta, v. 28, no. 1, 1964 p 67–86 refs Previously published as NASA CR-50173; see N63-16779 14-12
(NASA Contract NASw-579)

Abundances and selected isotopic ratios of the 14 rare-earth elements (REE), yttrium, and scandium have been determined by neutron-activation analysis in 13 meteorites and 2 terrestrial specimens: 3 carbonaceous, 2 hypersthenic, and 1 bronzitic (troilite phase) chondrite; 2 calcium-rich and 2 nakhlitic achondrites; 1 mesosiderite; 2 pallasites; an Australian eclogite; and a Columbia Plateau basalt. Author

N64-18335* Florida State U., Tallahassee
POLARIZATION OF 16-Mc/s RADIATION FROM JUPITER
C. H. Barrow Repr. from Nature, v. 201, no. 4915, 11 Jan. 1964 p 171
(NASA Grant NsG-224-61)

Twenty-seven polarization observations were made from June 7 until August 27, 1962, of radiation from Jupiter. These observations were made at 16 mc/s using the simple two-receiver and hybrid-circuit arrangement. During this period, 15 events were recorded, identification being made by the auroral-monitoring technique. Eight of the events were sufficiently satisfactory, with respect to intensity, duration, and reception conditions, to be roughly equivalent to the Class I and Class II events specified by Douglas and Smith. Of these eight events, seven occurred during periods when λ was somewhere within the range $215° \leq \lambda_{III} \leq 280°$. The noise bursts in these events were 99% right handed. The other event occurred when $116° \leq \lambda_{III} \leq 134°$. The noise bursts in this event were 42% left handed. I.v.L.

N64-18419* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PLANETARY POSITION – VELOCITY EPHEMERIDES OBTAINED BY SPECIAL PERTURBATIONS

P. R. Peabody and Neil Block Repr. from AIAA Journal, v. 1, no. 12, Dec. 1963 p 2812–2815 refs Presented at the ARS 17th Ann. Meeting and Space Flight Exposition, Los Angeles, 13–18 Nov. 1962

(NASA Contract NAS7-100)

(NASA CR-53617; JPL-TR-32-545)

Position-velocity ephemerides of Venus and the Earth–Moon system have been generated using special perturbation methods in which conditions at initial epoch are determined so that the subsequent positions are in best agreement with the Newcomb ephemerides in the least-squares sense. The ephemerides so obtained made possible the 1961 radar observations of Venus and were used in the subsequent determination of the published value of the astronomical unit. They are also being used in generating acquisition ephemerides for future radar observations of Venus and in calculating preflight Mariner standard trajectories. Comparison of the residuals between the Newcomb and the new ephemerides discloses clearly the major discrepancies in the Newcomb theory. The success of the method has led to the current development of an ephemeris library system that will be used to develop internally consistent position-velocity ephemerides of all the planets and the Moon and that will be of greatest possible accuracy over long arcs. Author

N64-18431* Massachusetts Inst. of Tech., Cambridge Lab. for Nuclear Science

X-RAY PRODUCTION IN SUPER NOVA REMNANTS

G. W. Clark and M. Oda [1963] 7 p refs

(NASA Grant NsG-386; Contract AT(30-1)-2098)

(NASA CR-53591) OTS: $1.10 ph

Several hypotheses are formulated to explain the existence of a concentrated X-ray source in the constellation Scorpio. One suggestion is that the source is a supernova remnant about 30-l.y. away. Such a remnant, with a total electron energy of 10^{50} erg, could produce a sufficient amount of X-rays to explain the observation, either by the Compton effect or by bremsstrahlung. Another possibility is that the source is a remnant in the very early phase of a relatively distant supernova obscured by a dust cloud. Observational tests of these ideas are possible. E.W.

N64-18434* Boston U., Mass.

CALCULATION OF LUNAR SURFACE AREA

David Friesen Feb. 1964 14 p refs

(NASA Grant NsG-246-62)

(NASA CR-53588; *Its* Astron. Contrib. Ser. 2 no. 32; Res. Rept. 14) OTS: $1.60 ph

The problem of calculating the actual lunar-surface area S, represented by an area A on a photograph of the moon, is discussed. The area A is projected onto the lunar surface, and the resulting area S is calculated by integrating the projection of A over the limits of A. A computer program was written that calculates the areas S of the subsection of an area A. The method is one of numerical integration using Simpson's rule. The program has been coded for both the IBM 1620 and the IBM-90-94 series. Coding in both cases is in FORTRAN II. Input is interchangeable between the two programs. R.T.K.

N64-18453* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

SPECTROSCOPIC RESEARCH ON THE MAJOR PLANETS

Hyron Spinrad Repr. from Applied Optics, v. 3, Feb. 1964 p 181–186 refs

(NASA Contract NAS7-100)

(NASA CR-53574; JPL-TR-32-550)

Recent results in planetary spectroscopy of Jupiter, Saturn, Uranus, and Neptune are summarized. Some methods of analysis for atmospheric composition and thermal and kinematic characteristics are described. Author

N64-18454* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

AN ANALYSIS OF THE SPECTRUM OF MARS

Lewis D. Kaplan, Guido Münch, and Hyron Spinrad Repr. from Astrophys. J., v. 139, no. 1, 1 Jan. 1964 p 1–15 refs

(NASA Contract NAS7-100)

(NASA CR-53573; JPL-TR-32-554)

On a high-dispersion spectrogram of Mars, rotational lines of H_2O near λ 8300 and CO_2 near λ 8700 have been detected. Recent laboratory measurements of line strengths have been used to determine the amounts of H_2O and CO_2 in the atmosphere of Mars: $14 \pm 7\mu$ precipitable water and 55 ± 20 m atm CO_2. From the absence of O_2 in the Martian spectra, an upper limit of 70 cm atm for the O_2 content has been set. By suitably combining the CO_2 amount with observations by Kuiper and Sinton of the strongly saturated bands in the 2μ region, a surface pressure of 25 ± 15 mb has been derived. The implications of the results on the composition of the Martian atmosphere are discussed. Author

N64-18459 Defence Research Board, Ottawa (Canada) Directorate of Scientific Information Services

AN IRON METEORITE SHOWER

I. S. Astapovich Apr. 1964 3 p refs Transl. into ENGLISH from Priroda, (Moscow), v. 10, 1963 p 87–89 refs

(T-387-R)

Iron fragments have been found in the southwest sector of the Turkmenian S.S.R. These have been associated with the passage of a bright bolide over this region on the 12th of July, 1948. This object belonged to the top class of superbolides. Because of its horizontal flight, the bolide traveled quietly, without explosions and bursts. The descending bolide came into the denser layers of the atmosphere, becoming visible at a height of over 100 km. It ceased to be visible at a height of 79 km. During the descent, its color changed from greenish blue through silver gray to orange, and, finally, to red. This color scale, which occurs during natural cooling, ordinarily corresponds to the bolide's loss of speed. Ten to twenty kg of meteoric iron were picked up after the flight. Since there were many fragments, the event is referred to as an iron meteorite shower. R.T.K.

N64-18460 Harvard Coll. Observatory, Cambridge, Mass.
INTERPLANETARY DEBRIS NEAR THE EARTH
Gerald S. Hawkins (Smithsonian Astrophys. Obs.) [1963] 45 p refs Submitted for Publication

The objects that bombard the earth from outer space are discussed. These objects cover a range of mass from millions of tons to 10^{-16} gram, and their physical characteristics depend upon their masses. The flux of objects into the earth's atmosphere has been fairly well established for the entire meteor population. The results of various measurements are presented; these show that the number of particles increase with decreasing mass. It is possible to draw a monotonic curve over the entire range from micrometeorites to meteorites. The characteristics of the various groups in the meteor population are described. The damage caused to satellites by the impact of meteoroids is also discussed. R.T.K.

N64-18471 Harvard Coll. Observatory, Cambridge, Mass.
ATOMIC HYDROGEN IN GALAXIES
Eugene E. Epstein [1963] 113 p refs Work done jointly with Aerospace Corp. George R. Agassiz Radio Astronomy Preprints (Supported by NSF)
(HRAP-111)

This paper deals with all currently available 21-cm HI emission-line observations of galaxies—40 galaxies investigated with the Harvard maser-equipped, 60-ft antenna and 8 galaxies previously investigated elsewhere. HI emission was positively detected from 3 Sb, 13 Sc, and 13 Ir galaxies; for the galaxies from which HI emission has not been detected, upper limits have been established. The bluer or "later" galaxies definitely tend to have higher values of M_{HI}/L_{pg}, M_{HI}/M, and σ_{HI} and smaller values of M than the less blue galaxies; σ_{HI} is the mean HI areal density when one projects the entire HI mass onto the fundamental plane of the Galaxy. The average values of the pertinent parameters for the detected Sb, Sc, and Ir galaxies are given. The values of M_{HI}/L_{pg} and σ_{HI} are independent of the distance estimates. The paper also presents average values and upper limits for undetected galaxies. Author

N64-18472 Harvard Coll. Observatory, Cambridge, Mass.
PRELIMINARY INVESTIGATIONS OF MODEL DISTRIBUTIONS OF ATOMIC HYDROGEN IN GALAXIES
Eugene E. Epstein [1962] 27 p refs Work done jointly with Aerospace Corp. George R. Agassiz Radio Astronomy Preprints (HRAP-112)

Two series of idealized galaxy models are investigated. The purpose of this investigation is to: (1) generate 21-cm HI line profiles similar to the observed profiles; (2) assess the effects of the galaxies' different apparent sizes and position angles on the observational homogeneity of the Harvard data; and (3) obtain some familiarity with the likely values of the optical depth and with the variations of the HI line profiles as a function of the galaxies' inclination angles and rotational motions. Author

N64-18473* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERNATIONAL DICTIONARY OF GEOPHYSICS, DYNAMIC SATELLITE GEODESY
W. M. Kaula [1964] 16 p refs
(NASA TM X-51584) OTS: $1.60 ph

The application of celestial mechanics to the computation of artificial satellite orbits is developed mathematically. The perturbations introduced by atmospheric drag and other effects (e.g., oblateness of the earth, radiation pressures, lunar solar effects, etc.) are discussed. P.V.E.

N64-18496 Wisconsin U., Madison. Geophysical and Polar Research Center
A SURVEY OF DATA ON MICROSCOPIC EXTRATERRESTRIAL PARTICLES
Richard A. Schmidt Jan. 1963 86 p refs
(Res. Rept. 63-2)

A survey of data on the following particles is presented: cosmic dust, meteoritic dust, micrometeorites, meteoric dust, and interplanetary dust. The objective of this survey was to bring together as much available data as possible. Principal attention was devoted to the following information about these particles: description, size, physical properties, chemical composition, occurrence, location of samples, annual deposit, and theories of origin. I.v.L.

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-17902 Massachusetts Inst. of Tech., Cambridge. Research Inst. of Tech.
MAGNETOHYDRODYNAMIC POWER GENERATION WITH LIQUID METALS
G. A. Brown, W. D. Jackson, and K. S. Lee *In its* Res. on New Concepts in Energy Conversion [1963] p 9–11 (See N64-17901 10-23)

A liquid-metal MHD power system employing a condensing ejector is discussed. The power system is intended for a space power system with a 300-kwe output. Calculations have been made to establish the pressure drops and weights for the boiler and radiator, including state-of-the-art results for the two-phase flow, which occurs in the boiler under zero gravity conditions. The cesium vapor was supplied to the condensing ejector at 2,400° R at various stagnation pressures. The cesium liquid entered the ejector at 1,600° R at 300 psia. These two streams are mixed in the condensing ejector so as to produce a liquid-cesium stream having a high stagnation pressure. The liquid cesium stream from the ejector is usually available at a high velocity and can be diffused to any desired stagnation pressure before entry into the generator. A diffuser efficiency of 90% has been used. A generator efficiency of 70% has also been employed. The cycle efficiency is very low, approximately 2% when the inlet vapor stagnation pressure is 30 psia, but increases steadily to approximately 12.5% at 170 psia. After passing through the MHD generator, the liquid cesium stream is split, with a fraction being returned to the boiler and the remainder being returned to the radiator. I.v.L.

N64-17997 Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
PRIMARY AND SECONDARY ELECTROCHEMICAL CELLS FOR SPACE VEHICLE POWER SUPPLIES
R. C. Shair Oct. 1963 38 p

The majority of missile and space applications use mercuric oxide–zinc, silver oxide–zinc, and ammonia-activated one-shot primary systems, and nickel–cadmium, silver–cadmium, and silver–zinc rechargeable secondary systems. Electrochemical characteristics of these systems and mechanical considerations in battery design are discussed. E.W.

N64-18052* IIT Research Inst., Chicago, Ill. Armour Research Foundation
SPACE BATTERIES
Howard T. Francis Washington, NASA, 1964 60 p refs
(NASA SP-5004) GPO: $0.25

This handbook is concerned with 3 sealed-battery systems: nickel–cadmium, silver–cadmium, and silver–zinc. Descriptions are given of their basic electrochemistry, their characteristics with regard to charging and discharging rates, their behavior on overcharge, their sensitivity to high and low temperatures, their energy-storage capability, their life expectancy, and their reliability. I.v.L.

N64-18073 General Motors Corp., Indianapolis, Ind Allison Div.
RESEARCH AND DEVELOPMENT OF AN ADVANCED LABORATORY LIQUID METAL REGENERATIVE FUEL CELL Third Quarterly Technical Progress Report, 1 Sep.–30 Nov. 1963
J. D. Mangus 13 Dec. 1963 74 p refs
(Contract AF 33(657)-11032)
(EDR 3673; AD-425422)

A successful single-cell test of 433-hr duration was run. During this testing, continuous discharges of up to 32 hr were maintained. This test produced power densities in the 50- to 100-watts/ft^2 range. Fabrication of the three-cell unit was completed, as was a large portion of the laboratory setup for testing. All instrumentation development was completed and proved with cell operation. Flow problems associated with a three-cell unit were studied through testing. Conductivity studies on new ceramic materials were conducted that yielded encouraging results, predicting internal resistances of about 1/3 to 1/2 of those currently being found. Author

N64-18074 General Motors Corp., Indianapolis, Ind. Allison Div.
RESEARCH AND DEVELOPMENT OF AN ADVANCED LABORATORY LIQUID METAL REGENERATIVE FUEL CELL Second Quarterly Technical Progress Report, 19 May–31 Aug. 1963
J. D. Mangus and H. R. Karas 9 Sep. 1963 116 p refs
(Contract AF 33(657)-11032)
(EDR-3547; AD-418027)

A successful 68-hr seal was produced. All the ceramic materials readily available were investigated for chemical compatibility and mechanical strength. This led to the selection of magnesia as a suitable matrix material. Investigations were also conducted on matrix configurations to determine the most desirable configuration for mechanical strength without sacrificing electrical properties. This led to the selection of a matrix with reinforcing ribs. With these tasks completed, work is now underway to adapt the seal configuration and matrix design to a three-cell unit. In conjunction with this, studies are underway to investigate the liquid metal flow problems associated with a three-cell unit, and single-cell testing is progressing to demonstrate electrical performance. Preliminary checks of electrochemical properties yielded encouraging results, predicting performances in the 50- to 100-watts/ft^2 range. Author

N64-18104* Electro-Optical Systems, Inc., Pasadena, Calif.
BRAYTON CYCLE SOLAR COLLECTOR DESIGN STUDY Monthly Progress Report, 1–31 Dec. 1963
D. E. Stewart 15 Jan. 1964 25 p refs
(NASA Contract NAS3-2782)
(NASA CR-53357; EOS-4150-M-6) OTS: $2.60 ph

This report summarizes reflectivity tests of samples prior to micrometeorite degradation tests, time averaged orientation efficiency assumptions, blade grinding and polishing, and structural and thermal analysis. A bar chart schedule and a work progress estimate are also included. Author

N64-18105* Hughes Aircraft Co., Culver City, Calif. Aerospace Group
SOLAR ENERGY COLLECTOR Monthly Report No. 4
S. S. Schwartz Dec. 1963 4 p
(NASA Contract NAS1-3244)
(NASA CR-53355) OTS: $1.10 ph

Work was carried out in an attempt to reduce the weight required for the gel coats to be adhered to the polyester stiffening layer of a rigid solar-energy collector. Gel coats utilizing epoxy-polysulfide mixtures and epoxy-polyamide mixtures were tested with no marked improvements. Each of the polysulfides appeared to have good adhesion to Mylar and to show good flexibility when cured. Polyester adhesion to the polysulfide coating, however, was uniformly poor, unless a fabric lock coat was used. Of the epoxy-polyamide mixtures tested, fair to good adhesion to the Mylar was achieved, and fair adhesion to the polyester resulted. The final optics, in each case, were poor. The surface, although not showing a fabric pattern, showed a fine "orange peel" effect. P.V.E.

N64-18108* Radiation Systems, Inc., Alexandria, Va.
RSI SATELLITE COMMAND ANTENNA ARRAY MODEL 071-024. VOLUME II: MECHANICAL Final Report
W. H. Burnett 1 Nov. 1963 36 p refs
(NASA Contract NAS5-3142)
(NASA CR-55806; Rept. TR-35, Vol. 2)

This volume discusses the mechanical design of the Satellite Command Antenna Arrays, Model 071-024, serial numbers 1 through 4. The four major areas treated in this report are: (1) maximum driving torque, (2) maximum overturn moment, (3) structural integrity, and (4) deflection and natural frequency. Items 1 and 2 were evaluated to insure that the array and pedestal were compatible. The investigation of item 3 was required to minimize the possibility of any mechanical failures. Item 4 consists of two parts, which are evaluated together. The deflection of the major components must be determined to insure that lowest natural frequency of the antenna must be examined to determine that it is out of the range of any expected oscillating live loads. The lowest natural frequency must be sufficiently high so that it will not be excited by the servo drive of the pedestal system. If energy is coupled into the system at its natural frequency, a resonant mode may increase the stresses within the structure to a point sufficient to produce failure. Author

N64-18162* American Cyanamid Co., Stamford, Conn. Stamford Research Labs.
RESEARCH AND DEVELOPMENT OF HIGH-PERFORMANCE LIGHT-WEIGHT FUEL CELL ELECTRODES 1st Quarterly Report, Nov. 1, 1963–Jan. 31, 1964
R. G. Haldeman, W. A. Barber, and W. P. Colman 3 Feb. 1964 98 p refs
(NASA Contract NAS3-2786)
(NASA CR-54022) OTS: $8.60 ph

The overall object of this contract is the reduction of the weight to power ratio of the hydrogen–oxygen fuel cell. Initial work has been concentrated on (1) materials studies including catalysts, supports, and matrices, (2) modification of thin-platinum screen-type electrodes, and (3) the development of evaluation procedures. Catalyst studies included preparation of high-area platinum blacks and evaluation

of Pt-Rh-carbon systems. Studies of matrix materials indicated an asbestos-poly(vinyl alcohol) composition to show promise. Electrode variables included platinum loading, porosity, Teflon content, and support screen structure. Design and operation of life testing equipment are described. Author

N64-18213* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
SUNFLOWER TURBOALTERNATOR CSU I-3 2348 HOUR TEST SUMMARY REPORT
Jan. 1964 128 p refs
(NASA Contract NAS5-462)
(NASA CR-53528; ER-5432, Rev. A)

CSU I-3 test results generally fulfilled all of the stated objectives established at the outset of testing. Bearing performance was an important aspect of this test in view of earlier bearing wear experience. The results exceeded expectations. No signs of wear, erosion, or dimensional changes could be found as a result of the operational test exposure, despite indicated heavy radial loadings from shaft imbalance and the presence of significant half shaft speed whirl throughout the test. The turbine bearing was damaged slightly by the forces of shutdown and exhibited a trace of corrosion on the sleeve. This corrosion was attributed to excess bearing operating temperatures. The results of the test also provided greater insight into the thermal clearance change characteristics, bearing element temperatures, and Hg lube supply requirements for the bearings. The CSU I-3 was operated at various design and off-design test conditions, both over and under its normal ratings, and demonstrated varying degrees of performance for the complete package and its subcomponents. Author

N64-18219* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Ninth Monthly Progress Report, 12 Aug.-12 Sep. 1963
V. L. Decker and T. F. Nagey 27 Sep. 1963 5 p
(NASA Contract NASw-476)
(NASA CR-53527; EDR-3548) OTS: $1.10 ph

Work to eliminate cracks in the fine grain composite continued. Three composites tested in small cells, each showing evidence of matrix cracking before tests, were completed. The last cell gave more than 12 hr of open circuit performance under limited operating conditions. Gas permeability testing to date indicates that the KOH-KBr-KI eutectic-MgO composite is gas tight up to 32 in. H_2O equivalent pressure. Author

N64-18283* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Third Monthly Progress Report, 12 Feb.-12 Mar. 1963
V. L. Decker and T. F. Nagey 25 Mar. 1963 4 p
(NASA Contract NASw-476)
(NASA CR-53347; EDR-3259) OTS: $1.10 ph

The current program status is as follows: (1) Conductivity measurements were completed for 31%, 33%, and 35% electrolyte composites. (2) The first of the 2-in.-diam matrices was prepared for testing. First analysis indicates that the cell functioned for at least 1 hr before degradation occurred. This was indicated by a very unstable open circuit voltage. I.v.L.

N64-18284* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Fifth Monthly Progress Report, 12 Apr.-12 May 1963
V. L. Decker and T. F. Nagey 25 May 1963 8 p
(NASA Contract NASw-476)
(NASA CR-53349; EDR-3360) OTS: $1.10 ph

A new coarse-grain composite electrolyte batch (34% electrolyte) showed strength values of 2.75 psi at 350° C and a 20% linear deformation before cracks appeared. Strength and flow-ability tests were completed on fine-grain composite specimens made from 55%, 57.5%, and 60% electrolyte. Nine conductivity specimens were made, using the fine-grain composite—three each of the 55%, 57.5%, and 60% electrolyte-content batches. A comparison of conductivity of the fine-grain composites showed an improvement in conductivity at 300° C by a factor of three. The coarse grain averaged out at approximately 0.1 mho/cm, whereas the value for the fine grain was near 0.3 mho/cm. Compatibility studies were initiated to obtain some insight into the quality control on the composite matrix materials. A number of tests were completed, and the conditions, results, and conclusions are presented. P.V.E.

N64-18285* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Sixth Monthly Progress Report
V. L. Decker and T. F. Nagey 26 Jun. 1963 3 p refs
(NASA Contract NASw-476)
(NASA CR-53350; EDR-3418) OTS: $1.10 ph

The current program status includes the following: (1) A critical review of the procedure for the preparation of the composite was made. (2) Strength testing of the coarse-grain composite is complete, and evaluation of the total data is in progress. (3) Strength testing of the new 63% fine-grain composite is complete. (4) Two 2-in. × 1/8-in. disks have been prepared for small-cell tests, a 34% and a 63% composite. (5) Compatibility tests of a 63% composite indicated that the material will not support itself, i.e., will run from harness prior to immersion in the test pool. (6) Results from compatibility tests of the new 34% coarse-grain composite are encouraging. This material withstood an 18-hour test. Analysis of the disk is in progress. I.v.L.

N64-18286* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Seventh Monthly Progress Report, 12 Jun.-12 Jul. 1963
V. L. Decker and T. F. Nagey 26 Jul. 1963 4 p ref
(NASA Contract NASw-476)
(NASA CR-53348; EDR-3476) OTS: $1.10 ph

The following improvements were made in composite fabrication: (1) An argon flooding cabinet was built to handle all steps in the composite fabrication procedure that were previously done in air. (2) Holders were built for each specimen, using 1/4-in. plexiglass sheets separated and sealed by rubber O-rings. These holders were tested and proved gastight. (3) A batch of 34% electrolyte composite was reprocessed to remove moisture and improve homogeneity and purity. A 2-in. × 1/8-in. disk was prepared from the reprocessed 34% electrolyte composite. This disk was used as an electrolyte matrix in the small cell rig. Three new batches of fine grain composite were prepared for testing—50/50, 60/40, and 70/30 electrolyte/MgO ratios. R.T.K.

N64-18287* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Eighth Monthly Progress Report, 12 Jul.-12 Aug. 1963
V. L. Decker and T. F. Nagey 26 Aug. 1963 5 p
(NASA Contract NASw-476)
(NASA CR-53352; EDR-3530) OTS: $1.10 ph

Two small cells were tested. One cell was the last of the coarse grain composites. The other cell was the initial unit of the second generation fine grain composites. A series of 1-in.-diam × 1/8-in. specimens were made to evaluate variations in quality and strength resulting from changes in baking procedure. No significant improvements were made, but the best overall combination was observed to be baking under argon, on gold plate, using a slow cooling rate. In addition seven batches of fine-grain composites using light calcined MgO were prepared. Strength and flow tests have shown the normal trend to be high strength with low saturation. The 69.3% electrolyte composite was highly fluid without strength. R.T.K.

N64-18288* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Tenth Monthly Progress Report, 12 Sep.-12 Oct. 1963
V. L. Decker and T. F. Nagey 25 Oct. 1963 6 p
(NASA Contract NASw-476)
(NASA CR-53351; EDR-3626) OTS: $1.10 ph

Two small cells were successfully tested during the period. Each matrix was fabricated from a 65% electrolyte composite, using a final sift through a 200-mesh screen prior to cold-press forming. The X-ray examination did not reveal any flaws or suspect flaws. A change in procedure and conditions was incorporated in order to minimize the severity of the test on the primary specimen, the cell matrix. The anode material was changed to an amalgam. The choice of a 32% molar amalgam was made to gain the highest melt point on the liquid-solid phase diagram. The melt point, approximately 280° C, of the selected amalgam is near the cell operating temperature and serves to automatically release the anode material to the cell at the proper condition. The high melt point also simplifies the amalgam loader design, since a valve is not required to control introduction of the metal. Research activities in composite fabrication are also included. R.T.K.

N64-18289* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Eleventh Monthly Progress Report, 12 Oct.-12 Nov. 1963
V. L. Decker and T. F. Nagey 25 Nov. 1963 17 p
(NASA Contract NASw-476)
(NASA CR-53353; EDR-3644) OTS: $1.60 ph

Some final conductivity test data and performance data for three 3-inch-diameter cells were compiled during this period. All the conductivity data for the present program are presented in tables. The three cells were operated, and results of the tests are presented in tabular form. E.W.

N64-18337 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TAPCO Div.
SUNFLOWER SOLAR RANKINE SYSTEM: MERCURY CORROSION AND CORROSION PRODUCT SEPARATOR STATUS SUMMARY
16 Apr. 1963 42 p
(ER-5302)

Test results are presented for Sunflower package developmental test rigs fabricated from a 300 series stainless steel. It is concluded that the use of a more corrosion-resistant material throughout the system, supplemented by a preconditioning operation, and incorporating corrosion product trapping provisions, should reduce to about 0.01 $in.^3$ the amount of corrosion products that would be generated in the system in one year's operation. Throughout all tests on the Sunflower package, no detrimental corrosion or deposition occurred in the bearing areas. The freedom from contamination and deposition of corrosion products in these areas is linked with the observation that flow restrictions occur in portions of the system where cold sections of the hardware exist in the flow stream, i.e. when the material of the restriction is colder than the flowing mercury. It is noted that whereas it is difficult to clear up blockages that have already occurred, heat applications can effectively prevent an accumulation of contaminates in the system. E.W.

N64-18374 Technical Operations Research, Burlington, Mass.
SOME TECHNIQUES TO HELP IMPROVE METHODS FOR EXERCISING AND EVALUATING COMMAND AND CONTROL SYSTEMS Summary Report [15 Dec. 1962-30 Nov. 1963]
Peter Kugel and Martin F. Owens 31 Jan. 1964 116 p refs
(Contract AF 19(628)-2455)
(ESD-TDR-64-195; AD-433162)

Four techniques are described: (1) exercise flow diagram—generalizes and extends the techniques of flow charting for use in exercising; (2) resource assignment model—uses techniques of mathematical logic to describe the information processing in the command and control system; (3) expected utility model—uses techniques drawn from decision theory to describe decision making in a command and control system; and (4) finite automaton model—uses techniques from the theory of finite automata to describe the relationships between a command and control system and the system exercising it. Author

N64-18388 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
WEBBED DENDRITIC SILICON SOLAR CELL RADIATION EFFECTS INVESTIGATION Technical Documentary Report, 1 Jan. 1963-1 Jan. 1964
R. V. Babcock and K. H. Sun Wright-Patterson AFB, Ohio, Flight Vehicle Power Branch, Mar. 1964 107 p refs
(Contract AF 33(657)-10527)
(APL-TDR-64-20; AD-434706) OTS: $2.25

An investigation has been conducted to determine the optimum structure for silicon solar cells, with regard to resistance to damage by 2-Mev electrons. The parameters considered were cell type, i.e., P/N or N/P, junction depth, and base resistivity. Of all the parameters affecting cell radiation resistance, the initial efficiency was found to have the largest effect. A comparison was made to assess the superiority of the optimum N/P structure over the optimum P/N structure for 2-Mev electron-flux densities in the range 10^{13} to 10^{15} electrons/cm^2. The degradation rate per decade of flux for the P/N structure was about 25% vs 21% for the N/P cells. The performance of the optimum N/P structure was evaluated at various temperatures in the range −80° C to +80° C for both the presence and the absence of electron irradiation. The maximum power of the cells is found to decrease about 20% at the high temperature extreme, as compared to that at room temperature. Author

N64-18414 Atomic Energy Commission, Washington, D.C.
SYSTEMS FOR NUCLEAR AUXILIARY POWER An Evaluation

D. H. Stewart, G. M. Anderson, G. Y. Jordy, and M. Wiener
Jan. 1964 39 p
(TID-20079)

This report presents evaluations of: (1) the SNAP-2/10A programs; (2) the SNAP-8 program; (3) the lithium-cooled-reactor experiment; (4) the SNAP-50 program; (5) alternate nuclear-auxiliary-power systems, which include the boiling potassium reactor, the Brayton (gas) cycle, and thermionic energy conversion; and (6) the SNAP isotope program. I.v.L.

N64-18417* AiResearch Mfg. Co., Los Angeles, Calif.
LIQUID HYDROGEN RECOVERY SYSTEM STUDY Final Report
K. L. Bush, G. V. Schwent, and H. G. Starck 19 Mar. 1964 202 p refs
(NASA Contract NAS3-2751)
(NASA CR-54010; AIR-K-520) OTS: $14.00 ph

The report is divided into the following sections: (1) recovery system thermodynamics; (2) Aerojet E-2 area test facility; (3) turbine design studies; (4) power absorption equipment; (5) systems analysis; (6) control system study; (7) cost analysis; and (8) safety and reliability. Five appendices cover the following: (1) heat exchanger recovery; (2) heat leakage and cooldown relations; (3) turbomachinery design studies; (4) controls dynamic analysis; and (5) cost estimates. Author

N64-18441* Livingston Electronic Corp., Montgomeryville, Pa.
DEVELOPMENT OF HIGH ENERGY DENSITY PRIMARY BATTERIES; 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT MINIMUM Third Quarterly Report (9th Reporting Period), 20 Nov. 1963-16 Feb. 1964
W. F. Meyers [1964] 104 p refs
(NASA Contract NAS3-2775)
(NASA CR-54024) OTS: $9.10 ph

Nearly all batteries today are based upon a water solvent. The object of this research is to examine other solvents in order to develop a higher energy battery. Research activities are reported in the following areas: (1) specific resistance and decomposition potential; (2) electromotive cell test—membrane cells, membrane permeability, pilot cells in butyrolactone, and pulse catalysis of aqueous cathodes; (3) electromotive cell tests using Livingston battery hardware; (4) research cell and separator resistance measurements; and (5) materials-compatibility evaluation—a summary of work done to determine the compatibility of ion-exchange membranes, separators, and materials of construction when immersed in solvents saturated with various salts under ammonia, sulfur dioxide, and carbon dioxide atmospheres. R.T.K.

N64-18474 General Precision, Inc., Little Falls, N.J. Aerospace Research Center
OPTIMUM CONTROL OF AN AERODYNAMICALLY UNSTABLE BOOSTER
Bernard Friedland 30 Nov. 1963 43 p refs
(Res. Rept. 63-RC-8)

The general problem of designing an autopilot to achieve optimum response of an aerodynamically unstable booster is considered. The vehicle is represented by a second-order linear model, and the actuator is represented by a first-order model having rate and position limits. The maximum principle of Pontryagin is employed to obtain general conditions that the optimum control law must satisfy, and it is shown that operation at either maximum rate or maximum deflection is optimum. The exact switching surface for time-optimum control is calculated, and expressions are obtained for the maximum stability region. A simple suboptimum control law was devised, and its performance was investigated by analog simulation. The results achieved showed that this suboptimum control law yields excellent performance and realizes the maximum stability region. Author

N64-18478 Saskatchewan U., Saskatoon (Canada)
VERY HIGH PRESSURE HYDRAULIC CONTROL SYSTEMS
P. N. Nikiforuk Montreal, Engineering Inst. of Canada 1963 14 p refs
(EIC-63-MECH-17)

A discussion is presented of the advantages of very-high-pressure hydraulic control systems (over 3,000 psi) over other types of control systems (electrical, compressed air, etc.) in applications in which large amounts of power and high speeds of response are required. The prime advantage of very high pressure is that more power can be packaged into a smaller envelope. The concepts of hydraulic control are discussed as are the various types of hydraulic drives, pumps, motors, and control valves. P.V.E.

N64-18485 France. Office National d'Etudes et de Recherches Aéronautiques, Chatillon-sous-Bagneux
OPTIMUM THERMODYNAMIC CYCLE FOR A SPACE TURBOCONVERTER SYSTEM [CYCLE THERMODYNAMIQUE OPTIMAL POUR UN SYSTEME TURBOCONVERTISSEUR SPATIAL]
Jacques Michard Repr. from Rech. Aérospatiale, no. 97, Nov.-Dec. 1963 p 31-35 refs In FRENCH; ENGLISH summary (*Its* T.P. No. 84(1963))

Two optimization calculations are suggested to determine the working conditions of an energy turboconverter system. One calculation aims at reducing the radiator area to a minimum and leads to limiting the ratio of the extreme temperatures to 0.75. The other calculation, only valid in the case of a solar source, optimizes the weight of the energy input–output system and, for concentration ratios around 500, lowers the ratio of the extreme temperatures to 0.5. In this case, the collector-radiator system weighs only 15.4 lb/kw. Author

N64-18502 Goodyear Aerospace Corp., Litchfield Park, Ariz. Arizona Div.
PREPROTOTYPE SOLAR COLLECTOR 15-KW SOLAR MECHANICAL POWER GENERATOR SYSTEM, PHASE I: DEVELOPMENT OF SPRAY TECHNIQUE OF RIGIDIZATION
28 Feb. 1964 50 p
(Contract X557500)
(GER-10252/S14)

This report presents a detailed account of the research and development progress relative to spray rigidizing. The progress is followed from initial equipment and materials surveys through the demonstration carried out on the uncovered area of the 44.5-foot mirror (on which foam had previously been applied). I.v.L.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-17970 Brussels U. (Belgium)
VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXI: MASS SPECTROMETRIC STUDIES OF THE VAPORIZATION OF THE SULPHIDES OF CALCIUM, STRONTIUM AND BARIUM. THE DISSOCIATION ENERGY OF S_2 AND SO
R. Colin, P. Goldfinger, and M. Jeunehomme Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1964 36 p refs
(Contract AF 61(052)-225)
(WADD-TR-60-782, Pt. 21; AD-433213)

CaS, SrS, and BaS have been evaporated and the vapor analyzed by mass spectrometry. The following thermochemical data were obtained: D°_o (S_2) = 97 ±5; D°_o (CaS) = 73.7 ±4.5; D°_o (SrS) = 74.1 ±4.5; D°_o (BaS) = 94.7 ±4.5; ΔH(dim.BaS) = 113.9 ±5; ΔH_{298vap}(CaS) = 148.0 ±5; ΔH_{298vap}(SrS) = 143.0 ±5; ΔH_{298vap}(BaS) = 122.5 ±5; D°_o (CaO) = 84.4 ±6; D°_o (SrO) = 92.2 ±6; D°_o (BaO) = 130.4 ±6; and D°_o (SO) = 123.5 kcal per mole. Author

N64-17979 California U., Berkeley. Lawrence Radiation Lab.
THE REACTION OF FERRICYANIDE WITH BOROHYDRIDE IN AQUEOUS SOLUTION
Lydia S. Hsu (M. S. Thesis) Jan. 1964 30 p refs
(Contract W-7405-ENG-48)
(UCRL-11252) OTS: $0.75

The kinetics of the reaction of ferricyanide with borohydride (in the concentration ranges for both reactants of 0.1 to 0.5*M*) has been studied in alkaline aqueous solution at room temperature. The reaction was found to be catalyzed by glass surfaces. This catalysis, however, can be avoided by using wax-coated surfaces. The rate of change of the hydroxide ion concentration was found to be first order in both ferricyanide and borohydride and independent of the hydroxide ion, at least in the high-pH region, with a rate constant of $4.93 \times 10^{-4} M^{-1}$ min^{-1}. This result is different from that found by Freund for very dilute ferricyanide and borohydride ion in buffered aqueous solution. Under the conditions of Freund's experiments, no glass catalysis was observed. Author

N64-17984 Bureau of Mines, Boulder City, Nev.
ANALYSIS OF HIGH-PURITY COLUMBIUM BY OPTICAL EMISSION SPECTROGRAPHY
Lloyd Carpenter and James M. Nishi 1964 20 p refs
(BM-RI-6414)

Sixteen elements were determined spectrochemically in the general range of 3 to 1,000 ppm in high-purity columbium. Samples were converted thermally to Cb_2O_5, mixed with graphite and GeO_2, and excited for 15 seconds using a 15-amp d.c. arc. For the molybdenum determination, the oxidized samples were mixed with NaCl and GeO_2 and excited for 30 seconds. Spectra were recorded on photographic plates, and spectral line transmittance values were measured photometrically. Relative-intensity ratios of selected analytical and internal standard spectral lines were plotted against concentrations of standards to form curves from which concentrations of impurities were read. Average precision of the method was 11.2 percent relative standard deviation. Author

N64-18003 Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF TRACE AMOUNTS OF HYDROGEN IN SODIUM METAL
Ross D. Gardner and William H. Ashley 31 Mar. 1964 14 p refs
(Contract W-7405-ENG-36)
(LA-3049) OTS: $0.50

The classical combustion–gravimetric method for the determination of hydrogen has been modified and applied to the measurement of trace amounts of hydrogen in sodium metal. The sample, contained in an aluminum capsule, was reacted with a flux of silica sand at 1 000 C in an atmosphere of argon. Following this, the combustion was completed in an atmosphere of oxygen. The resulting water was absorbed in $Mg(ClO_4)_2$ and weighed. An average recovery of 100% with a standard deviation of 8 ppm was obtained for the analysis of 50 samples containing known amounts of hydrogen in the 0 to 600 ppm range. Author

N64-18083 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR SEPTEMBER, 1963
J. F. Eichelberger, G. R. Grove, and L. V. Jones 30 Sep. 1963 17 p refs
(Contract AT-33-1-GEN-53)
(MLM-1176)

Research activities in the following areas are summarized: (1) development of silicone-based conductive adhesives; (2) radioelements research—residue adsorption, half-life of tritium, polonium-208–polonium-209 purification, polonium process waste disposal, actinium-227 separation, uranium-234 separation; (3) neutron measurements and polonium alpha sources; and (4) calorimetry investigations. P.V.E.

N64-18090 California U., Berkeley. Lawrence Radiation Lab.
BIO-ORGANIC CHEMISTRY Quarterly Report, Sep.-Nov. 1960
M. Calvin et al. 31 Jan. 1961 67 p refs
(Contract W-7405-ENG-48)
(UCRL-9519) OTS: $1.50

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1. COACERVATION OF SALTS OF POLYVINYLSULFONIC ACID INDUCED BY HEAVY-METAL IONS Frank Millich p 5–19 refs

2. THE CONDENSATION OF HYDROQUINONE WITH ISOPRENE P. R. Hammond p 20–22 refs

3. πBONDING IN INORGANIC OXYACIDS P. R. Hammond p 23–25 refs

4. THE DEAMINATION OF ADENINE, ADENOSINE, AND 3′- ADENYLIC ACID BY THE ACTION OF IONIZING RADIATION Cyril Ponnamperuma, Richard M. Lemmon, and Edward L. Bennett p 26–29 refs

5. IRRADIATION OF METHANE, AMMONIA, HYDROGEN, AND WATER Christof Palm and Melvin Calvin p 30–39 refs

6. CRYSTAL VIOLET AS A REACTION PRODUCT OF THE CHARGE-TRANSFER COMPLEX OF DIMETHYL ANILINE AND °- CHLORANIL Gerrit Engelsma and John W. Eastman p 40–41 ref

7. ON THE CORRELATION OF THE PHOTOINDUCED ESR SIGNAL IN SPINACH CHLOROPLASTS WITH THE PRESENCE OF PIGMENTS IMPORTANT TO HILL REACTIVITY Gaylord M. Androes and Mary C. Singleton p 42–47 refs

8. THE FIXATION OF CARBON-14 IN ISOLATED CHLOROPLASTS Ulrich Herber p 48–52 refs

9. DETECTION OF CARBOXYLIC ACIDS ON PAPER CHROMATOGRAMS Josephine Hill and J. A. Bassham p 53–57 refs

10. AN ATTEMPT TO IDENTIFY A SUPPOSED ATP PRECURSOR E. Tyszkiewicz p 58–61 refs

11. CONVERSION OF A LIQUID SCINTILLATION DETECTOR UNIT FOR ROOM-TEMPERATURE OPERATION Fritz Woeller and Fred Vogelsberg p 62–64

12. FURTHER STUDIES ON THE MECHANISM BY WHICH D_2O PRODUCES STERILITY IN MALE MICE Ann M. Hughes p 65–66

N64-18175* Stevens Inst. of Tech., Hoboken, N.J.
A QUANTITATIVE STUDY OF SOLUTIONS THROUGH GAS CHROMATOGRAPHY First Semi-Annual Report, 1 Sep. 1963–10 Mar. 1964
Francis B. Clough 10 Mar. 1964 13 p refs
(NASA Grant NsG-494)
(NASA CR-53391) OTS: $1.60 ph

Results of an investigation of the thermodynamics of dilute nonelectrolyte solutions by means of gas–liquid chromatography are discussed in general. Conditions that must be satisfied for the valid determination of activity coefficients by gas–liquid chromatography are examined. In analyzing the interactions between molecules in solution, 44 solutes (including aromatic, aliphatic, and halogenated hydrocarbons) were studied in 8 different carrier liquids of low volatility. The values for the experimentally obtained activity coefficients appear to be consistent with the effect of size and with the intermolecular forces (dispersion, dipole-induced dipole, dipole–dipole, hydrogen bonding, etc.), which are known to be operative in the liquid phase. However, the shortcomings of contemporary solution theories in providing an adequate theoretical understanding of activity coefficients are stressed. M.P.G.

N64-18191 Army Missile Command, Huntsville, Ala.
A POLAROGRAPHIC STUDY OF OXIDATION INHIBITORS: NITRODIPHENYLAMINES AND NITRORESORCINOLS IN ETHANOL
Peter P. Petro, Jr. and A. F. Findeis 2 Dec. 1963 23 p refs
(RK-TR-63-26; AD-434073)

A polarographic study was made of the oxidation inhibitors 2-nitrodiphenylamine (NDPA); 2,4-dinitrodiphenylamine (DNDPA); 2, 2', 4, 4', 6, 6'-hexanitroresorcinol (TNR); and 2,4-dinitrosoresorcinol (DN_sR). Diffusion coefficients and the number of electrons transferred in the corresponding reductions at a dropping mercury electrode were determined. The applicability of polarographic techniques to the rapid quantitative analysis of the foregoing compounds was demonstrated. Author

N64-18215* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
REACTION BETWEEN NITRIC OXIDE AND OZONE IN A SUPERSONIC NOZZLE
J. E. Marte, E. Tschuikow-Roux, and H. W. Ford Repr. from J. Chem. Phys., v. 39, no. 12, 15 Dec. 1963 p 3277–3285 refs
(NASA Contract NAS7-100)
(NASA CR-53532; JPL-TR-32-494)

The rate of reaction between nitric oxide and ozone in a supersonic nozzle was measured in the temperature range 245° to 345° K by following the absorption of ultraviolet radiation by ozone at 2537 A. The specific rate constant was found to be $k = 1.19 \times 10^{12} e^{-2500/RT}\ cm^3 \cdot mole^{-1} \cdot sec^{-1}$. The result is in good agreement with previous studies and confirms the bimolecular nature of the reaction. The experimental preexponential factor is in satisfactory agreement with one calculated from transition state theory. Author

N64-18248 Oak Ridge National Lab., Tenn.
THE PERFORMANCE OF AN ADVANCED EXPERIMENTAL STACKED-CLONE CONTACTOR: A HIGH-PERFORMANCE SOLVENT EXTRACTION MACHINE WITH POTENTIAL FOR APPLICATION TO VERY HIGHLY RADIOACTIVE SOLUTIONS
M. E. Whatley and W. M. Woods Apr. 1964 55 p refs
(Contract W-7405-ENG-26)
(ORNL-3533) OTS: $1.50

A high-performance liquid–liquid extraction contactor, called the stacked-clone contactor, has been developed through the stage of identifying an optimum design of the configuration of the functioning components. The device consists of hydroclones cascaded such that the underflow port of each hydroclone communicates with the overflow of the one below by an underflow chamber. Each stage is comprised of a hydroclone, an underflow chamber, and a pump. The principle of operation and the characteristics are discussed. Author

N64-18254 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
AQUEOUS BEHAVIOR OF ALUMINUM OXYCHLORIDE
B. Siegel and R. L. Johnson 2 Mar. 1964 14 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-22; TDR-269(4210-10)-5; AD-434442)

Anhydrous AlOCl dissolves readily in water to form a solution that is stable toward hydrolysis, even at 100° C. Concentrated solutions disproportionate appreciably to aluminum trichloride and aluminum oxide at 100°, but not at 60° C. The strong conductance of aqueous AlOCl solutions, combined with freezing-point-depression data, indicate that dissolved AlOCl is polymerized. A crystalline hydrate $AlOCl \cdot 2.5H_2O$ has been isolated. Pyrolysis of this hydrate at 100° C leads to the formation of a lower hydrate, approaching the composition $AlOCl \cdot H_2O$. At temperatures of 200° to 300° C, pyrolysis of the hydrate leads to an almost anhydrous AlOCl. However, these pyrolytic dehydration reactions are accompanied by a competing reaction that evolves HCl and forms AlO(OH). The latter compound can be kept to a minimum by carrying out the pyrolysis at higher temperatures where dehydration requires shorter reaction times; data indicate that the dehydration reaction is more temperature dependent than is the reaction forming AlO(OH) + HCl. Author

N64-18259 Cincinnati U., Ohio
MATERIALS ANALYTICAL RESEARCH Technical Documentary Report, 15 Jun. 1960–31 Mar. 1963
Michael Hoch Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1963 51 p refs
(Contract AF 33(616)-7450)
(ASD-TDR-63-620; AD-427027)

This report summarizes analytical research on experimental organic and inorganic materials using as the main approach such techniques as infrared, far infrared, ultraviolet and visible absorption spectroscopy, electrical procedures, gas chromatography, X-ray and spectrographic methods, mass spectroscopy, and organic and inorganic chemical analysis. Author

N64-18309 Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING SI-N BONDS IN THE MAIN CHAIN Summary Report No. 3, 1 Jul. 1963–31 Dec. 1963
L. W. Breed and R. L. Elliott 1963 22 p refs
(Contract DA-23-072-ORD-1687)
(AD-432392)

Polymers with substantially improved hydrolytic stability have been prepared by the condensation of N-substituted

cyclotrisilazanes with bisphenol "A". Model silazane compounds were used to study potential methods of crosslinking silazane-diol polymers. Author

N64-18321* Florida State U., Tallahassee Inst. for Space Biosciences
ASYMMETRIC SYNTHESIS OF α-AMINO-ACIDS BY THE STRECKER SYNTHESIS
Kaoru Harada Repr. from Nature (London), v. 200, no. 4912, 21 Dec. 1963 p 1201 refs
(NASA Grant NsG-173-62)
(*Its* Contrib. 17)

A brief description is given of the asymmetric synthesis of L-alanine. The general method of asymmetrically synthesizing α-amino acids in solution involves (1) the reaction of an aldehyde with hydrogen cyanide and D-(−)-α-methylbenzylamine in methanol, (2) the hydrolysis of the resulting amino nitrile to the N-(α-methylbenzyl) amino acid, and (3) catalytic hydrogenolysis to remove the methylbenzyl group. The production of 0.68 gram of pure N-(α-methylbenzyl) analine, and subsequent hydrogenolysis to 95% optically active L-analine, is outlined. I.A.A.

N64-18397 Los Alamos Scientific Lab., N. Mex.
CHEMICAL DETECTORS. A BIBLIOGRAPHY FOR THE INDUSTRIAL HYGIENIST WITH ABSTRACTS AND ANNOTATIONS
Evan E. Campbell and Helen M. Miller, comps. 31 Mar. 1964 465 p refs
(Contract W-7405-ENG-36)
(LAMS-2378 (Vol. 2)) OTS: $5.50

The abstracts in this bibliography are arranged alphabetically by compounds. Those in Volume I ranged from A through E; those in this volume go from F through Z. In addition, this volume contains Addenda to Volume I, bringing the bibliography up to the end of 1963. Author

N64-18413 Little (Arthur D.) Inc., Cambridge, Mass.
THE EFFECT OF ELECTROPHILIC ADDITIVES ON THE RADIOLYTIC PRODUCTS OF ORGANIC CHAIN REACTIONS
Final Report
Philip L. Levins, El-Ahmadi I. Heiba, and Donna D. Mc Ritchie Oak Ridge, Tenn., AEC Div. of Tech. Inform., 31 Dec. 1963 54 p refs
(Contract AT(30-1)-2904)
(NYO-10025) OTS: $1.25

The reactions induced by high-energy radiation of isobutane–propylene mixtures, isobutane, and olefins adsorbed on silica gel and silica gel modified with electrophilic additives have been studied. The effects of such variables as electron percent coverage, variation in metal oxide, method of incorporation and concentration of ferric oxide, mole ratio of reactants, and choice of olefin were determined. Extensive energy transfer from the support to the adsorbed hydrocarbon was demonstrated for each hydrocarbon studied. Enhanced yields were observed for the propylene alkylation of isobutane on modified silica gels compared with that obtained on silica gel. The alkylation was shown to proceed preferentially by an ionic reaction mechanism. The possibility of utilizing high-energy radiation to promote ionic chain reactions with an efficient use of the radiation energy has been demonstrated. These results are in distinct contrast with the usual free radical reactions observed in radiation studies of hydrocarbons. Author

N64-18449* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE OCCURRENCE OF CHAIN TRANSFER IN THE ANIONIC POLYMERIZATION OF 9-VINYLANTHRACENE
A. Eisenberg and A. Rembaum Repr. from J. Polymer Sci., Pt. B, Polymer Letters, v. 2, 1964 p 157–162 refs Presented at the 14th Natl. Amer. Chem. Soc. Meeting, New York, 9–13 Sep. 1963
(NASA Contract NAS7-100)
(NASA CR-53570; JPL-TR-32-576)

In order to elucidate the reason for the exclusive formation of low-molecular-weight polymers (during an attempt to prepare high-molecular-weight poly-9-vinylanthracene), even when using high M_0/X_0 ratios, anionic polymerization of poly-9-vinylanthracene in tetrahydrofuran (THF) was studied (where M_0 is the original monomer concentration and X_0 the concentration of "living ends"). From the results of the study, it was concluded that: (1) The linearity of all the kinetic experiments in THF indicated that the concentration of active sites remains constant throughout the run, and, therefore, chain termination by impurities cannot occur to any significant extent. It also indicates that the reaction obeys the relationship: $-(dM/dt) = k_pXM$, where X is the initiator concentration and M the monomer concentration. (2) The maximum degree of polymerization obtainable by an anionic mechanism is limited by a chain transfer reaction, most probably to monomer. (3) The ratio of the chain transfer rate constant to the propagation rate constant is essentially independent of concentrations, nature of the solvent, counterion, and temperature. P.V.E.

N64-18451* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
GRAFT AND BLOCK COPOLYMERS OF SOME VINYL AROMATIC HYDROCARBONS
A. Rembaum, J. Moacanin, and E. Cuddihy Repr. from J. Polymer Sci., Pt. C, no. 4, 1964 p 529–549 refs Presented at the Intern. Symp. on Macromol. Chem., Paris 1–6 Jul. 1963
(NASA Contract NAS7-100)
(NASA CR-53572; JPL-TR-32-474)

The aromatic moieties of vinyl polymers, such as poly-4-vinylbiphenyl and poly-2-vinylnaphthalene, react in solution with alkali metals to form colored charge-transfer complexes. These polymers, referred to as polyradical anions, initiate the polymerization of ethylene oxide by bond formation, thus leading to the formation of graft polymers. The polyradical anions, however, may degrade at ambient temperature into polymeric anions. Therefore, to prepare graft polymers, suitable polymer systems as well as reaction conditions that minimize the degradation process must be selected. Graft and block copolymers having poly-4-vinylbiphenyl or poly-2-vinylnaphthalene backbones and polyethylene oxide branches were prepared, and the properties of these compared to those of homopolymers and blends. The reaction mechanisms and relative stabilities of the various species are discussed in terms of molecular orbital calculations. Author

N64-18486 France. Office National d'Etudes et de Recherches Aéronautiques, Chatillon-sous-Bagneux
COPOLYCONDENSATION OF BORON AND PHOSPHORUS DIFUNCTIONAL ACIDS [COPOLYCONDENSATION D'ACIDES DIFONCTIONNELS DU BORE ET DU PHOSPHORE]
Bertrand Bloch Repr. from Rech. Aérospatiale, no. 98, Jan.–Feb. 1964 p 37–42 refs In FRENCH; ENGLISH summary (*Its* T.P. No. 97 (1964))

Following a survey dealing with the interest and the present state of advancement of studies concerning the P-O-B-O

polymers, the properties of a series of condensation products of difunctional acids of phosphorus with butylboronic acid (and with boric acid in some cases) are given. These compounds—very likely mixed anhydrides of low molecular weight—may be appropriate in some cases for a reversible transformation into resinlike products. But if they seem to constitute a defined chemical class, it has not yet been possible to give them a well-defined structure. Author

N64-18501 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
RADIOASSAY OF THIN-LAYER CHROMATOGRAMS BLUEPRINTS FOR ZONAL SCRAPER
Fred Snyder, T. J. Alford, and Harry Kimble Washington, AEC, Apr. 1964 8 p refs Blueprint drawings by Harvey Underwood
(Contract AT(40-1)-GEN-33)
(ORINS-44) OTS: $0.50

The radioassay of thin-layer chromatography (TLC) plates, previously described by the author, was improved by designing a scraping device for rapid and quantitative transfer of extremely small zones of adsorbent from narrow glass plates into counting vials. A sketch and the blueprint drawing of the thin-layer chromatography zonal scraper are included. R.T.K.

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-17843 Royal Inst. of Tech., Stockholm (Sweden) Speech Transmission Lab.
ACOUSTIC SPECIFICATION OF SPEECH
C. G. M. Fant 28 Jan. 1963 13 p refs
(Grant AF-EOAR-62-82)
(AFCRL-63-174; AD-422282)

Results from studies of speech analysis, speech synthesis, and speech perception related to the specification of acoustical determinants of voice quality, speech sounds, and other phonetic categories and speech message units are summarized with reference to work and publications from the Speech Transmission Laboratory during 1962. Design features of instrumentation for speech analysis and synthesis are reviewed. Author

N64-17878* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
STATISTICAL COMMUNICATION THEORY
Y. W. Lee, A. G. Bose, M. Schetzen, H. L. Van Trees, V. R. Algazi et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 175–186 (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

A generalization of the principle of superposition is discussed, and the class of nonlinear systems that obeys this generalized principle is investigated. The investigation is carried out within the framework of linear algebra. The results obtained concerning homomorphic systems seem to indicate that this is a useful means of classifying many nonlinear systems. The canonical representation of these systems permits their investigation in terms of linear systems. Some results are presented of studies concerning the distribution of energy in transient functions. R.T.K.

N64-17880* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
PROCESSING AND TRANSMISSION OF INFORMATION
R. M. Fano, R. G. Gallager, F. C. Hennie, III, T. S. Huang, I. M. Jacobs et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 193–207 refs (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03; Contract AF 19(628)-500)

The following are discussed: (1) picture processing—the subjective effects of pictorial noise, and coding color pictures; (2) an experimental facility for sequential decoding; (3) an error bound for fixed time-continuous channels with memory—vector dimensionality problem, and random-coding bound. R.T.K.

N64-17895 Michigan U., Ann Arbor Cooley Electronics Lab.
DERIVATION OF AEROSPACE ANTENNA COUPLING, FACTOR INTERFERENCE PREDICTION TECHNIQUES Interim Technical Report No. 7, Aug. 1–Nov. 1, 1963
D. K. Adams, W. R. De Hart, R. M. Kalafus, A. I. Simanyi, R. B. Harris et al Wright-Patterson AFB, Ohio, Aeronautical Systems Div. Jan. 1964 23 p refs
(Contract AF 33(657)-8178)
(AD-434099) OTS: $2.60

Three Archimedean spirals were tested for antenna patterns and coupling patterns: (1) circular, (2) square, and (3) dielectric-cavity-backed circular. The latter was used in the fundamental mode, with out-of-phase currents at the feed. The square spiral exhibits a broader beam, a better ellipticity ratio, and a larger VSWR over the band (in this case, 2 to 4 gc) than is true of the circular spiral. The effect of the dielectric is to broaden the beam, since the antenna radiates from a smaller region. Another square spiral, oppositely wound, was tested for coupling patterns, and found to exhibit essentially mirror-image behavior to the first square spiral. A theoretical consideration of mounted flush-horn antennas indicates that rough estimates of coupling may be obtained rather simply from curves given herein. The feed and the geometry of the horn determine the aperture field distribution; this, in turn, determines the fields in space and along the ground plane. Phase variations due to horn flare, for example, tend to smooth out sidelobes and broaden the beam. Author

N64-17962 Illinois U., Urbana
STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES Third Quarterly Report, 1 Sep.–31 Nov. 1963
Murray D. Sirkis et al Griffiss AFB, N.Y., RADC, Feb. 1964 16 p refs
(Contract AF 30(602)-3046)
(RADC-TDR-64-28; AD-433121)

This program has as its goal the development of video detection techniques that are appropriate for the millimeter and submillimeter range of the spectrum. Wafers of TGS have been mounted in both RG 99/U and RG 139/U waveguides for tests of the pyroelectric effect detector. It is estimated that the detector, when mounted in RG 139/U waveguide, is capable of detecting a 10μ watt signal at a wavelength of 0.845 mm. An error in calculation of the beam waveguide reflector shape has

been corrected. Experimental results are only slightly affected by the change in the reflector shape. Author

N64-17996 National Bureau of Standards, Boulder, Colo.
PERFORMANCE PREDICTIONS FOR SINGLE TROPOSPHERIC COMMUNICATION LINKS AND FOR SEVERAL LINKS ON TANDEM
A. P. Barsis, K. A. Norton, P. L. Rice, and P. H. Elder Aug. 1961 161 p refs
(NBS-TN-102; PB-161603) OTS: $3.00

Performance of long-distance tropospheric communication circuits, either singly or in tandem, is predicted in terms of the probability of obtaining a specified grade of service or better for various percentages of time. The grade of service is determined by the minimum acceptable ratio of hourly median predetection-RMS-signal-to-RMS-noise for the type of intelligence to be transmitted. The standard deviation of prediction errors depends upon the percentage of hours the specified grade of service is required and on parameters characterizing the propagation path. The possibility of reducing this standard deviation by making path-loss measurements is discussed. It is shown that no improvement is possible unless the test path is very nearly the same as the proposed operational path. Author

N64-18054 Joint Publications Research Service, Washington, D.C.
RADIOTELEGRAPHY
M. V. Verzunov 3 Mar. 1964 71 p Transl. into ENGLISH of a Russian pamphlet Moscow, Mil. Publishing House of the Defense Min. USSR, 1961 p 1–80
(JPRS-23500; OTS-64-21706) OTS: $1.75

The report covers the following: (1) radiotelegraphic methods and radiotelegraph signal parameters; (2) amplitude keying—frequency spectrum, circuits, and signal reception; (3) frequency keying—oscillation parameters, oscillation spectrum, circuits, and disturbance stability; (4) telegraph keying in multichannel operation; (5) phase keying—single-channel and two-channel phase telegraphy; (6) methods of improving radiotelegraphy-communications stability; and (7) remote-transmitter keying. E.K.R.

N64-18088 Federal Aviation Agency, Atlantic City, N.J. National Aviation Facilities Experimental Center
EVALUATION OF UHF TRANSMITTER-EXCITER TYPE TU-5 Final Report
R. B. Frack Dec. 1963 60 p refs

An evaluation was conducted on a UHF Transmitter-Exciter, Type TU-5, to determine its suitability for operational use as a low-level transmitter and as an exciter for the UHF Transmitter Coupler Amplifier, Type FA-5271. Performance parameters, such as output power, frequency stability, distortion, and intermodulation products, were measured and compared with the UHF Transmitter, Type T-282/GR, presently in use by the FAA. Author

N64-18092 Joint Publications Research Service, Washington, D.C.
DYNAMIC BIOTELEMETRY
V. V. Rozenblat 27 Mar. 1964 36 p refs Supplemented version of a rept. presented at the 2d All-Union Conf. on the Use of Radioelectron. in Biol. and Med., Leningrad, 27 Apr. 1962 Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 56, no. 3(6), 1963 p 341–364
(JPRS-23910; OTS-64-21918) OTS: $1.00

A general survey of the use of radiotelemetry in medico-biological investigation is presented with particular emphasis on dynamic biotelemetry. After a brief history of the development of biotelemetry, the working classifications of biotelemetry (onboard, dynamic, endoradioprobe, retranslation or relay, and stationary) are defined. Dynamic biotelemetry deals with the remote recording of physiological data by radio during unrestricted physical movement of the subject. The general characteristics of the transmitting and the receiving–recording apparatus for dynamic biotelemetry are discussed. The applications of dynamic biotelemetry considered include: sport physiology, with particular emphasis on cardiac function; work physiology, especially during physical labor; and clinical physiology, particularly for diagnostic evaluation. The future prospects of dynamic physiology are seen to depend upon close cooperation between design engineers and physiologists, the use of existing facilities mainly for applications that cannot be investigated in other ways, and increased production of biotelemetric apparatus. M.P.G.

N64-18118 Federal Aviation Agency, Atlantic City, N.J. National Aviation Facilities Experimental Center
MICROWAVE RADIATION HAZARD TO AIRCRAFT TRANSITING RADIO AND RADAR BEAMS Final Report
John J. Kulik Dec. 1963 42 p refs
(RD-64-1)

A hazard to aircraft transiting high-power-density radio and radar beams exists unless appropriate safety measures are practiced. Susceptibilities of humans, aircraft fuel vapors, avionics, and electroexplosive devices to microwave radiation indicate limits of power densities of electromagnetic radiation to which aircraft may be safely exposed. From a study of the literature and the analyses that were conducted, it is concluded that aircraft not carrying electroexplosive devices may be safely exposed to average power densities of 10 mw/cm^2 or less. Aircraft carrying electroexplosive devices may be safely exposed, under some conditions, to power densities of 1 mw/cm^2. This report contains charts, and procedures for using them, that give distances along the antenna beam axis at which the aforementioned limits are reached. Author

N64-18132* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. VOLUME II: SYSTEM TOPICS – PART ONE Final Report
7 Feb. 1964 97 p refs
(NASA Contract NASw-540)
(NASA CR-53467) OTS: $8.60 ph

Results are presented of tests on star observations, on photomultiplier performance, and on the effects of the atmosphere on laser propagation. The study supported the belief that optical communication has the potential to replace radio and to perform unique functions in many space situations. Certain methods are proposed to overcome the restriction of receivers to small-area-collecting optics in the atmosphere and to high-quality optics in any case. C.L.W.

N64-18133* General Electric Co., Philadelphia, Pa. Valley Forge Space Technology Center
OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. VOLUME III: SYSTEM TOPICS – PART TWO Final Report
7 Feb. 1964 123 p refs
(NASA Contract NASw-540)
(NASA CR-53466) OTS: $10.10 ph

The following are discussed with respect to optical space-communications systems: (1) photomultiplier detectors—performance of photomultiplier detectors on signals that are close to the noise level of the detector; (2) effect of atmospheric

turbulence on laser propagation—absorptive attenuation, scattering (nonabsorptive attenuation), "seeing" effects caused by random fluctuation in the index of refraction of the air, and potential high-energy effects; and (3) laser optics—transmitting optics, receiving optics, filtering, and detection of faint sources. P.V.E.

N64-18207 France. Office National d'Etudes et de Recherches, Aeronautiques, Chatillon-sous-Bagneux
INFRA-RED SITOMETRE [SITOMETRE INFRAROUGE]
Nicole Louisnard. Repr. from Rech. Aeron. (Chatillion-sous-Bagneux), no. 96, Sep.-Oct. 1963 p 51-56 refs. In FRENCH; ENGLISH summary
(*Its* T.P. No. 77(1963))

The sitometer has been designed to measure the angle of elevation of an infrared source moving at high speed. After a description of the principle of the apparatus (line of sight occulted by a coded grid) and of its various components, the factors acting on the sensitivity and the performance are discusssed. The first tests using a Mach 12 reentry nose cone at a distance of 150 km have permitted measurement of altitudes with an absolute error on the order of 150 m. Author

N64-18230* Sperry Gyroscope Co., Great Neck, N.Y.
TIME ADJUSTMENT AND AMBIGUITY RESOLUTION OF MINIVAR INPUT DATA
C. A. Laspina. *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 61-64 (See N64-18226 10-01)
OTS: $11.00 ph

Tracking data from both the Minitrack and Range and Range Rate (RARR) systems include errors in the time ascribed to the various quantities measured by these systems, which are approximately equal to the propagation time of the signals from the vehicles to the ground station. In addition, the RARR measures range with an ambiguity of approximately 11,000, 2,750, or 550 miles, depending on the lowest range tone used. Both the time adjustment and the ambiguity resolution require a knowledge of the approximate range to the vehicle, and hence both corrections will be made as part of the MINIVAR program, using a nominal range computed from the most recent estimates of the state variables. These errors and methods for correcting them are described for the Mini track system and the Range and Range Rate system. A technique for resolving RARR data is described. R.T.K.

N64-18240* Sperry Gyroscope Co., Great Neck, N.Y.
PROPAGATION CORRECTION
A. Cristina. *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 131-147 refs (See N64-18226 10-01)
OTS: $11.00 ph

Correction formulas for electromagnetic propagation through both the troposphere and ionosphere are presented. An exponentially decaying density is assumed for the troposphere, whereas a three-parameter model is used for the ionosphere; both models are numerically integrated to compute range and range-rate corrections in the troposphere. Coordinate systems and transformations required for making the corrections are described. R.T.K.

N64-18241 Defence Research Telecommunications Establishment, Ottawa (Canada). Communications Lab.
SOME CONSIDERATIONS IN SATELLITE COMMUNICATIONS SYSTEMS
B. C. Blevis, J. W. B. Day, R. M. Dohoo, and O. S. Roscoe. Jan. 1964 81 p refs
(DRTE-1122)

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1. INTRODUCTION. R. M. Dohoo. 6 p (See N64-18242 10-09)
2. PROPAGATION FACTORS AND ANTENNA NOISE. B. C. Blevis. 21 p refs (See N64-18243 10-08)
3. ANTENNAS FOR EARTH TERMINALS. J. W. B. Day. 20 p refs (See N64-18244 10-09)
4. LOW-NOISE RECEIVERS FOR EARTH TERMINALS. O. S. Roscoe. 19 p refs (See N64-18245 10-08)
5. THE REQUIREMENTS FOR ON-SITE COMPUTING FACILITIES. O. S. Roscoe. 5 p ref (See N64-18246 10-20)
6. SITING. R. M. Dohoo. 7 p refs (See N64-18247 10-10)

N64-18243 Defence Research Telecommunications Establishment, Ottawa (Canada). Communications Lab.
PROPAGATION FACTORS AND ANTENNA NOISE
B. C. Blevis. *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 21 p refs (See N64-18241 10-08)

The propagation effects at frequencies above about 10 Gc and the external sources of antenna noise at frequencies greater than 1,000 Mc are considered. The following factors that affect satellite communication systems are discussed: (1) ionospheric Faraday rotation, (2) refraction and scintillation, (3) signal attenuation due to absorption and scattering by atmospheric gases and condensed water, (4) external sources of antenna noise, including noise arising from tropospheric absorption, and terrestrial and extraterrestrial radio noise, and (5) systems considerations including free space propagation and signal and noise levels in typical satellite communications systems. R.T.K.

N64-18245 Defence Research Telecommunications Establishment, Ottawa (Canada). Communications Lab.
LOW-NOISE RECEIVERS FOR EARTH TERMINALS
O. S. Roscoe. *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 19 p refs (See N64-18241 10-08)

The relation between receiver and antenna noise temperature is presented. System sensitivity and its effect on low-noise receiver requirements are discussed. Also discussed are masers and parametric, tunnel-diode, and traveling-wave-tube amplifiers as applied in receiving systems for use in communications satellite terminals. R.T.K.

N64-18317 Joint Publications Research Service, Washington, D.C.
THE RTA-60 PAGE TELETYPE
V. V. Novikov. 24 Mar. 1964 12 p. Transl. into ENGLISH of an excerpt from the book "Inzhenerno-Tekhnicheskiy Spravochnik po Elektrosvyazi: Telegrafiya", Moscow, State Publishing House of Lit. on Probl. of Commun. and Radio, 1963 p222-229
(JPRS-23836; OTS-64-21876) OTS: $0.50

The apparatus consists of a transmitting set (keyboard, sender, automatic responder, and transmitter); receiving set (electromagnet, teletype device, receiving typesetting and resetting devices, coders and decoders, printing block, and reperforator); and driving mechanism (electric motor, transmission axles, automatic stop, and work-time meter). The design and principle of operation of these components are discussed, and specific technical data and features are included. The RTA-60 page teletype is intended for subscriber and customer communications services, Telex communications, and direct-connections networks. E.W.

N64-18355 Imperial Coll. of Science and Tech., London (Gt. Brit.)
THE DISTORTION OF CUMULONIMBUS PRECIPITATION OBSERVED BY RADAR Technical Scientific Note No. 13
J. R. Probert-Jones Nov. 1963 24 p refs
(Contract AF 61(052)-254)
(AFCRL-64-249; AD-434779)

The intensity of the returned signal at any point on a radar display is due to the backscattering from all the elements within the volume of the pulse. The depth of the pulse in range is only small, but its width both in azimuth and elevation is proportional to range, and significant power can be received from well outside the half-power points. This integration over the pulse volume produces a distortion of the intensity pattern, whose effect increases with range. A particular, but typical, beam pattern has been applied to two models of cumulonimbus precipitation to give the displayed, distorted intensity patterns. These show the very enlarged echo size, especially at great ranges; the height of the echo top can be several kilometers above the true precipitation top, and this is not due to side-lobes but to the edges of the main lobe of the beam. By applying the process in reverse to the displayed contours, a good approximation to the actual intensity contours can be obtained. Author

N64-18403 General Dynamics/Astronautics, San Diego, Calif.
GLOTRAC: GLOBAL TRACKING NETWORK FACT BOOK
19 Jun. 1963 33 p

The purpose of GLOTRAC, at present in the design, development, and installation phases, is to satisfy current and projected high-accuracy tracking requirements. GLOTRAC segment no. 1 includes continuous-wave and pulse-radar ground stations that operate with transponders and beacons installed in the flight vehicle. The continuous-wave ground stations developed for GLOTRAC are housed in vans; these stations can be relocated to serve new or revised tracking missions. GLOTRAC has the capability of computing tracking data in real time for automatic segment-to-segment target acquisition. All data are recorded and used for postflight computation of vehicle performance. GLOTRAC is described as follows: (1) principles of operation; (2) GLOTRAC requirements—GLOTRAC range-rate stations, unambiguous range, and canted base-line system; (3) continuous-wave transponders; (4) pulse-radar equipment; (5) GLOTRAC equipment; (6) data reduction; (7) packaging, growth potential, support, and installation. R.T.K.

N64-18442* General Electric Co., Philadelphia, Pa. Missile and Space Div.
OPTICAL SPACE COMMUNICATIONS SYSTEM STUDY. FINAL SYSTEMS STUDY, Vol. IV Final Report
3 Mar. 1964 34 p refs
(NASA Contract NASw-540)
(NASA CR-53581) OTS: $3.60 ph

It was found that optical communication in space offers a remarkable potential for efficient data transmission. This potential is about 60 db better than can be achieved by radio. Verification of the potential of optical communication in space, an evaluation of the alternative approaches that present themselves, and a specification of the work that must be done to realize a useful potential are discussed in particular. It is shown that a system can be constructed in principle that approaches the theoretical limit of efficiency. The system would be capable of providing real-time television transmission from the range of Mars with a transmitted power of about 1 watt. The selection of a recommended approach was reduced to a choice between heterodyne or amplitude responsive detection, and quantum counting or energy responsive detection. P.V.E.

N64-18468 National Research Council of Canada, Ottawa Radio and Electrical Engineering Div.
RADIO TELEMETRY FOR UPPER ATMOSPHERE SOUNDING ROCKETS
J. K. Pulfer Nov. 1963 25 p refs
(ERB-653)

The use of radio telemetry for upper atmosphere sounding is discussed from the experimenter's point of view. Factors affecting the accuracy and information-handling capabilities of telemetry systems are considered. The results of experimental measurements of errors in the standard FM-FM rocket telemetry system used by the National Research Council are given, and the effects of these errors on the design of experiments are discussed. Modifications of the FM-FM system to suit particular user needs, such as high accuracy, wide bandwidth, or the ability to transmit digital data, are considered in detail. Author

N64-18503* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE RETROMETER: A LIGHT-BEAM COMMUNICATIONS SYSTEM
Numa E. Thomas Washington, NASA, Mar. 1964 20 p
(NASA SP-5005) OTS: $0.50

A new system of voice communications transmitted on a beam of light is described. It differs from prior systems in that the originating station requires no power other than that of the human voice. The advantages and limitations of the Retrometer are briefly discussed, and some potential applications are analyzed. A detailed description of an experimental model is given. Author

N64-18512 Canada. Defence Research Board, Ottawa Directorate of Scientific Information Services
SURFACE-WAVE TRANSMISSION LINES USING THIN DIELECTRIC SHEET
Masao Sugi and Tsuneo Nakahara Apr. 1964 22 p refs Transl. into ENGLISH from J. Inst. Elec. Commun. Engr. Japan (Tokyo), v. 34, no. 8, 1959 p 731-737
(T-85-J)

This paper sets forth principles and some concrete examples of surface-wave transmission lines constructed of thin sheets or membranes. In particular, the case of TE-mode transmission by a thin dielectric cylinder, with calculation of the losses and comparison with other types of lines, is studied. In this type of transmission, the boundary conditions requisite for surface-wave propagation are established by the use of a nonconducting (dielectric) sheet material. To achieve a high efficiency, a structure was devised in which the dielectric material is parallel to the electric field and the magnetic material is parallel to the magnetic field. As examples of practically applicable designs, an O-guide and an X-guide are shown. These transmission lines may also be made in the form of an enclosed cable, by providing them with an external shield. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-17844 Innsbruck U. (Austria)
CALCULATION OF THE DIPOLE FIELD USING THE VLF APPROXIMATION
R. Hommel 10 Aug. 1963 15 p
(Contract AF 61(052)-490)
(AFCRL-63-516; AD-423437)

The radiation field of a horizontal magnetic dipole at a depth h under a flat part of the earth's surface is calculated at short range by the integral method, using the VLF approximation. The field strength in the main direction of radiation is evaluated numerically and compared with the values in the case of an infinite homogeneous medium. Author

N64-17887* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
CIRCUIT THEORY AND DESIGN
P. Penfield, Jr., R. P. Rafuse, C. L. Searle, and R. D. Thornton *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 281-293 refs (See N64-17876 10-01)
(NASA Grant NsG-419)

A compendium of some of the theoretical and experimental work on varactor multipliers is presented. An analysis has been carried out on the effects of "extra" (larger number than necessary) idlers on quadruplers and octuplers. An analysis has also been made on overdriven doublers using both abrupt-junction and graded-junction diodes with very simple models assumed for the forward characteristics. The results of studies of the overdriven doublers lead to simple analysis techniques for doublers using diodes with radical nonlinear capacitances. Some experimental circuits have been developed that yield stable, high-efficiency, low-spurious-content operation. The use of more idlers than necessary yields higher efficiency and power handling than does the use of just the necessary number. When overdriven, the graded junction shows higher efficiency than the abrupt junction in the doubler circuit. R.T.K.

N64-17923 Cornell U., Ithaca, N.Y. School of Electrical Engineering
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION First Quarterly Progress Report
T. Mihran et al Griffiss AFB, N.Y., RADC, Feb. 1964 57 p refs
(Contract AF 30(602)-3243)
(RADC-TDR-63-555; AD-433173)

Studies were conducted on the RF propagation along a d.c. scalloped beam. Progress was made on the development of equipment for measuring the RF propagation along confined-flow electron beams in varying magnetic fields and the growth of noise in scalloped and nonscalloped Brillouin beams. Analyses of the large-signal properties of two-cavity klystrons, and the properties of biased two-cavity klystrons were made using a computer. The response of klystrons to nanosecond RF pulses was investigated, and nonlinear space-charge wave analysis was carried out. The generation and diagnosis of a hydrogen plasma, plasma amplifier gain, direct coupling mechanisms, and electron beam stability were studied. High-level thermionic emission processes, laser-induced second-order photoelectric effects, and low-level thermionic emission were also studied. E.W.

N64-17964 Picatinny Arsenal, Dover, N.J. Nuclear Engineering Directorate
PREFERRED PROCEDURES FOR THE SELECTION, APPLICATION, AND HANDLING OF MULTICONTACT ELECTRICAL CONNECTORS
R. Van Ness Jun. 1963 29 p
(PA-TM-1242; SMUPA-TK-825; AD-434111) OTS: $2.60

This report suggests preferred methods and design features to overcome problems associated with the use of multicontact electrical connectors. Recommended sources for properly designed connectors are also included. Author

N64-17965 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
LOG PERIODIC DIPOLE ARRAY WITH PARASITIC ELEMENTS
Normand Barbano 30 Jan. 1964 41 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-M623; AD-433172)

The design and measured characteristics of dipole and monopole versions of a log periodic array with parasitic elements are discussed. In a dipole array with parasitic elements, these elements are used in place of every alternate dipole, thereby eliminating the need of a twisted feed arrangement for the elements to obtain log periodic performance of the antenna. This design with parasitic elements lends itself to a monopole version of the antenna, which has a simplified feeding configguration. The result is a log periodic antenna design that can be used from high frequencies through microwave frequencies. Author

N64-18001 Autonetics, Anaheim, Calif. Navigation Systems Div.
MICROELECTRONICS APPLICATIONS TO INERTIAL NAVIGATION
W. F. De Boice [1963] 24 p refs Presented at the Western Reg. Meeting of the Inst. of Navigation, Nov. 1963

Some key innovations are described. To solve the problem of the relatively high development costs for microelectronic circuits, a set of elementary electronic functions has been developed for use repetitively throughout the system, together with special adapting circuits that vary with the application. The set of seven standard functions for linear applications, and the results of the first application to a complete system are described. Some special standardization problems are discussed together with suggested direction for further effort. Author

N64-18015 Micro State Electronics Corp., Murray Hill, N.J.
LOW NOISE TUNNEL DIODE MIXERS AND CONVERTERS Final Report
Stuart Becker, Gerald Hiller, and Raoul Pettal Griffiss AFB, N.Y., RADC, 17 Dec. 1963 79 p
(Contract AF 30(602)-2631)
(RADC-TDR-63-561; AD-429176)

This report summarizes the theoretical and experimental effort on tunnel diode converters carried out under this program. Theoretical studies lead to a conclusion that reasonably low (< 10 db) noise figures are possible when the diode is biased near the valley. This allows the tunnel diode converter to be operated with positive input and output conductances, which simplify the stability problem. The development and fabrication of special tunnel diodes having exceptionally high cutoff frequencies (> 20 Gc) are discussed in some detail. Experimental models of tunnel diode converters at 900 mc and X-band are described, and a large number of measured results on available power gain, noise figure and noise temperature ratio are given for both germanium and gallium antimonide diodes. Author

N64-18032 Varian Associates, Palo Alto, Calif.
HIGH POWER R-F WINDOW STUDY PROGRAM Final Technical Report

Floyd Johnson Nov. 1963 90 p refs
(Contract AF 30(602)-2844)
(Rept. 304-1F; RADC-TDR-63-510; AD-433791)

The major portion of the program consisted of experimental evaluation of numerous window designs in a high-power resonant ring. Window configurations included thin and thick discs, resonant blocks, and double thin discs surface cooled with dielectric liquid. Window materials included the alumina and beryllia ceramics, quartz, boron nitride, and synthetic sapphire. As a result of the experiments, two specific window designs were found to be superior for use with large amounts of average power. These are the thin disc window made of synthetic sapphire and the resonant block window made of beryllium oxide. Each of these windows repeatedly withstood the maximum available test power of 260 kw. These two windows exhibited 20 and 25 percent bandwidth respectively. Another portion of this effort consisted of developing a technique for design of disc and block windows by computer. Author

N64-18082* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WIDE RANGE PHASE DETECTOR
George B. Robinson Washington, NASA, Apr. 1964 26 p refs
(NASA TN D-2269) OTS: $0.75

A 4-diode bridge-type phase detector of constant cosine response from 20 cps to 100 kc was developed as a part of an experimental phase-lock filter intended for operation in that range. A 6-transistor circuit drives the diode bridge. A wide-band resistive-T adder network, rather than the usual center-tapped transformer, supplies signal and reference inputs to the bridge. The output is balanced to ground; the internal resistance of the output circuit is 600,000 ohms. Total power consumption is 135 mw at 50 v. An analysis is made, which shows that the cosine response at the output terminals to be: $E_{OUT} = -1.28\ E_s(\cos n\alpha)\pi n$, for n odd; $E_{OUT} = 0$, for n even, where E_s = rms signal input, α = phase angle of the input signal relative to the input reference voltage, and n = integer ratio of signal frequency to reference frequency. Author

N64-18087 National Engineering Science Co., Pasadena, Calif.
ANALYSIS OF ILS GLIDE SLOPE ANTENNAS IN OPERATION AND UNDER DEVELOPMENT Final Report
Maurice G. Chernin Feb. 1964 135 p
(Contract FA-WA-4391)
(RD-64-11; SN-142)

ILS glide slope antenna systems are reviewed and evaluated from various standpoints, such as the installation site, weather conditions, compatibility with ICAO standards, and general effectiveness. Recommendations on several proposed modifications are made together with suggestions for future consideration. All existing FAA glide slope systems are considered as well as several prototype systems under consideration for future installation. Author

N64-18097 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
DEVELOPMENT OF RADIATION RESISTANT DIGITAL CIRCUITS
B. J. Donaldson 22 Oct. 1963 202 p refs
(SM-45766)

Because of the tremendous saving in power and space realized when using solid-state switches in lieu of other active elements (i.e., vacuum tubes, relays, pneumatic devices), it was decided to devote this first study to circuits employing semiconductor devices in spite of their known radiation sensitivity. The circuits were designed using the most radiation resistant components available, and employing circuit design techniques to compensate for the expected component degradation. Two tests were made to evaluate these circuits in a steady-state nuclear environment as provided by the training reactor facility at UCLA. These experiments proved the circuit design philosophy, and established an upper limit (10^{16} neutrons/cm^2, epicadmium) for the radiation tolerance of this type of circuit. Author

N64-18125 Joint Publications Research Service, Washington, D.C.
RADIO ELECTRONICS AND ADJACENT SCIENCES
V. Govyadinov and G. Smolyan 9 Apr. 1964 13 p ref Transl. into ENGLISH of an article from Kommunist (Moscow), no. 2, 2 Jan. 1964 p 87–95
(JPRS-24125; OTS-64-31040) OTS: $0.50

This report discusses: (1) the general tendencies of scientific progress in radio electronics development; (2) the manner in which achievements in radio electronics are tied to adjacent scientific areas and technologies such as physical chemistry, solid-state physics, molecular electronics, plasma physics, cybernetics, information theory, etc., and (3) suggestions for improving the coordination of research in radio electronics and in adjacent fields of knowledge. I.v.L.

N64-18142 Pratt and Whitney Aircraft, Middletown, Conn.
DESIGN AND DEVELOPMENT OF LCRE FISSION-COUNTER PREAMPLIFIER
G. F. Atkinson 31 Mar. 1964 58 p refs
(Contract AT(30-1)-2789)
(PWAC-427) OTS: $1.50

A four-tube preamplifier, capable of operating in a high-temperature, high-nuclear-radiation environment, was developed and tested for amplifying the pulse output of fission counters. The preamplifier uses ceramic electron tubes, deposited-carbon or metal-film resistors, glass-dielectric and porcelain-dielectric capacitors, ceramic-insert connectors, and soldered, terminal-board construction. Tested characteristics include a rise time of 40 nanoseconds, a linear output for negative input pulses to 25-millivolt amplitude, a gain of 25 when driving 200 feet of 50-ohm coaxial cable, a noise level at the output of 2.5 millivolts peak-to-peak, continuous operation at 250° F, and a construction throughout of components and materials that are inert to nuclear radiation. Author

N64-18161* General Electric Co., Waynesboro, Va.
STUDY OF CAPACITORS FOR STATIC INVERTERS AND CONVERTERS Second Quarterly Report, 16 Nov. 1963–16 Feb. 1964
J. F. Scoville 1964 18 p
(NASA Contract NAS3-2788)
(NASA CR-54020; R63SCW-31-2) OTS: $1.60 ph

Work accomplished in the following areas is discussed: (1) results of the state-of-the-art capacitor survey; (2) capacitor values selected for experimental testing; and (3) experimental test plans and objectives. Author

N64-18184 Sylvania Electric Products Inc., Mountain View, Calif. Electronic Defense Labs.
POLARIZATION COUPLING CURVES
Bernard J. Lamberty 27 Jan. 1964 20 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-M593; AD-433951)

This report presents curves of polarization coupling of antennas having various fixed values of axial ratio as a function of the axial ratio and orientation angle of incident waves. Some examples of the meaning and use of these curves for determining overall system parameters are discussed. Author

N64-18197 Illinois U., Urbana Antenna Lab
RESEARCH ON LOG-PERIODIC ARRAYS OF SLOTS Technical Report No. 3
J. W. Greiser Jan. 1964 29 p refs
(Contract NOBSR-85243)
(AD-434190)

A symmetrical slot design (i.e., one that radiates on both sides of the ground plane) is described. This design has shown excellent wideband pattern performance for a range of physical parameters. In addition, this new slot design has an exact electromagnetic dual in free space. The free space dual has image symmetry along its axis, thus allowing one half of the structure to be operated over ground as a log-periodic monopole array. Log-periodic zigzag slot antennas, log-periodic simple slot arrays, and log-periodic folded slot arrays are discussed. R.T.K.

N64-18208 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
ANTENNAS FOR MISSILES [ANTENNES POUR MISSILES]
Roger Gouillou Repr. from Rech. Aeron. (Chatillon-sous-Bagneux), no. 96, Sep.–Oct. 1963 p 58–61 In FRENCH; ENGLISH summary
(*Its* T. P. No. 78E(1963))

Some solutions used recently by O.N.E.R.A. for problems of experimental missile antennas are presented. A quick survey of the particular conditions concerning the performance of the missiles and a brief review of the theories related to radiation and the effect of kinetic heating are given. Author

N64-18222 Hughes Aircraft Co., Newport Beach, Calif. Development Lab.
ADVANCED FUNCTIONAL ELECTRONIC BLOCK DEVELOPMENT Fourth Interim Engineering Report, 15 Jul.–15 Sep. 1963
H. G. Dill 1963 48 p refs
(Contract AF 33(657)-9771)
(AD-419917)

This report consists of three parts. The first part compiles data on ambient and temperature studies of CdS thin-film devices. Water vapors were identified as a source for variation of the d.c. device parameters and are partly responsible for an l/f noise. Introduced states, due to adsorbed water vapors at the CdS-SiO_x interface and in the amorphous SiO_x layer, are sensitive to ambient changes and consequently result in variations of electrical characteristics, if not stabilized or ultimately eliminated. The l/f-noise measurements likewise indicate a change of noise with ambients and temperatures. The second part of the report discusses experimental work with a one-stage and a three-stage d.c. stabilized wideband amplifier. The circuit appears to be very useful for thin-film applications if more stable thin-film terminal devices become available. Problems concerning the bandpass amplifier and certain performance figures are discussed in the third part of the report. I.v.L.

N64-18242 Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab.
INTRODUCTION [TO SATELLITE COMMUNICATIONS SYSTEMS]
R. M. Dohoo *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 6 p (See N64-18241 10-08)

A summary of survey papers in the following areas is included: (1) propagation factors and antenna noise, (2) experimental hardware—antennas, low-noise receivers, on-site computing facilities, and (3) siting (site selection for a ground terminal). R.T.K.

N64-18244 Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab.
ANTENNAS FOR EARTH TERMINALS
J. W. B. Day *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 20 p refs (See N64-18241 10-08)

The performance characteristics of antennas that are important in satellite communications, and of some specific types of antennas now being used in this field are discussed. Also discussed is the relation between the physical and effective apertures and the antenna gain that is proportional to the effective aperture for a perfect reflector. The effect of surface roughness of reflectors is also considered. In determining the performance of a receiving antenna as part of a system it is necessary to consider the ratio of gain to system temperature. It is shown that an increase of antenna gain does not necessarily result in an improvement of the system signal-to-noise ratio because an increase of gain can be accompanied by an even greater increase of antenna noise. The characteristics of the parabolic reflector are discussed in detail. A brief discussion of horn-reflector antennas leads to the conclusion that although horn-reflector antennas have excellent efficiency, noise, temperature and bandwidth characteristics, it may be possible to get equivalent performance from parabolic antennas of smaller dimensions. R.T.K.

N64-18282* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH-EFFICIENCY MULTI NEEDS NO STANDBY POWER
Robert M. Munoz Repr. from EEE Circuit Design Eng., Oct. 1962 4 p

A transistorized multivibrator circuit is described that has an efficiency approaching 100 percent. The circuit uses no power during standby and sends virtually all available power to the load. The new multi uses complementary transistors in series to produce the nearly 100% efficiency. A single coupling network determines whether the circuit will be monostable, bistable, or astable. The monostable multi produces a rectangular, constant-width pulse. An input signal (not necessarily periodic) determines when the pulse will start, and circuit constants determine the pulse width. The bistable form of the new multivibrator circuit is limited because complementary output is not readily available. The astable multi produces periodic waveforms of high harmonic content—rectangular waveforms, square waves, trapezoids, and pulses. The circuit parameters determine the frequency and symmetry of these waveforms. P.V.E.

N64-18290* National Aeronautics and Space Adminstration. Marshall Space Flight Center, Huntsville, Ala.
RADIO FREQUENCY ELECTRIC FIELD ATTENUATION MEASUREMENTS FOR SHIELDED EQUIPMENT ENCLOSURES, STANDARD FOR
26 Jun. 1963 12 p
(NASA TM X-51534; MSFC-STD-280) OTS: $1.60 ph

This report deals with the establishment of the approved method for measuring the radiofrequency electric-field attenuation of shielded equipment enclosures. The signal sources shall be powered by dry-cell battery packs, and shall be capable of covering the frequency range of 0.05 to 1,000 mc. The power-output requirements for the signal source at any one frequency may be determined by the sum of: (1) the noise level

of the receiver in db; (2) the transmission path loss in db from the output of the signal source to the receiver input; and (3) the amount of attenuation in db required by the minimum attenuation limit. The receiver shall be capable of covering the frequency range specified for the signal source, and shall meet the following requirements: (1) The receiver shall have a metered output. (2) The dynamic input attenuation range shall be such that any input signal may be attenuated by at least 80 db. The antennas shall be as small as practicable in physical size, and shall allow maximum loading of the signal source. The attenuation of each enclosure shall be determined at a minimum of two frequencies per octave, or seven frequencies per decade, or every 50 mc, whichever is less over the frequency range of 0.50 to 1,000 mc. I.v.L.

N64-18310 General Electric Co., Schenectady, N.Y. Schenectady Tube Operation
HIGH-POWER TRAVELING-WAVE MULTIPLE-BEAM KLYSTRON Fifth Quarterly Progress Report, 1 Jul.-30 Sep. 1963
R. A. Dehn, J. S. Hickey, N. D. Jones, and W. J. Pohl [1963] 41 p ref
(Contract DA-36-039-AMC-00007(E); ARPA Order 345-62; Proj. Defender)
(AD-433620)

The hot testing and operation of the first S-band TWMBK are described. Measurements were made of the bandwidth and the correlation between hot-test and cold-test bandwidths established. Low-level and high-level gain measurements were made on the original version, in which 7 of the 10 beams were operative, and on the rebuilt tube in which all 10 beams were operative. The behavior of individual beams was also established. The electrical design of stagger-tuning pattern, cavity Q, and drift lengths has been completed. The computed power output is flat to ±0.5 db over a 180-megacycle band at a large signal gain of 45 db. Experiments with various dissipative materials placed in the eight-beam cavity to adjust Q to design values showed that the required low Q could not be achieved without significant distortion of resonator fields. A system in which power is coupled from each beam section to a centrally located slab of lossy material is now under test. Author

N64-18343 European Organization for Nuclear Research, Geneva (Switzerland) MSC Div.
A NEW GENERAL ALARM SYSTEM [UN NOUVEAU SYSTEME D'ALARME GENERAL]
F. Hoffmann 31 Jan. 1964 38 p In FRENCH
(CERN-64-7)

An alarm system designed for surveillance of a synchrocyclotron or similar equipment is described. The system operates on the principle of a continuous low-voltage current that is fed through contacts at a distance from each other to a relay that, when closed, completes the circuit and unlocks the equipment. The breaking of the circuit or a malfunction of the security system triggers the warning system. Each contact is linked to an alarm unit that checks the circuit and signals the state of that contact. The series of linked contacts terminates in an outlet unit that signals if the sequence is complete and commands the relay to close the circuit, permitting the operation of the equipment. Block diagrams of the circuitry are presented, and refinements of this system for working hours and for indicator lights, rather than alarm signals, are also described. M.P.G.

N64-18357 Lewis (E. B.) Co., Inc., East Hartford, Conn.
PRODUCTION ENGINEERING MEASURE (PEM) CRYSTAL UNIT Fifth Quarterly Report, Aug.-Nov. 1963
Robert P. Mc Comb [1963] 42 p
(Contract DA-36-039-SC-86737)
(AD-432930)

Work performed on the CR-(XM-46)/U in the frequency range 30 to 60 mc and an evaluation of a new plating configuration at 30 mc are presented. Also work performed at 60 mc concerning the effect of "plate back" on the level and distribution of unwanted modes is presented. A brief discussion of problems encountered in measuring filter crystal parameters is given. Author

N64-18363 Technical Research Group, Inc., Melville, N.Y.
MM-WAVE AMPLIFICATION BY RESONANCE SATURATION IN GASES Final Report
Benjamin Senitzky Griffiss AFB, N.Y., RADC, Mar. 1964 112 p refs
(Contract AF 30(602)-2744)
(RADC-TDR-63-562; AD-434764)

The power-saturated resonance absorption of a gas has been used to achieve mm-wave amplification. Experiments were conducted at room temperature in both a traveling wave system and in a resonant cavity. The results are in good agreement with theory. A gain of 20 db was obtained with a 6-in. long, 3/4-in.-diam cylindrical cavity at 86 gc. A theoretical analysis indicates that the inherent noise figure of this device is 7 db. Experimental noise measurements, which were limited by the sensitivity of the available test equipment, yielded an upper value of 25 db for the noise figure. Author

N64-18376 Research Triangle Inst., Durham, N.C. Solid State Lab.
SELECTED EXPERIMENTS IN SILICON INTEGRATED DEVICE TECHNOLOGY Final Report, Jan. 1963-Feb. 1964
R. M. Burger Mar. 1964 54 p refs
(Contract AF 33(657)-10340)
(AL-TDR-64-29; AD-432171)

This report summarizes the experimental work that was performed as supplementary investigation to the preparation of the "Silicon Integrated Device Technology" series. Supporting experimental work was done in three areas: (1) anodic oxidation of silicon for integrated circuits; (2) statistical methods for the evaluation of laboratory processes; and (3) impurity diffusion into silicon from a gas source. Phosphine gas was the first impurity gas investigated. Author

N64-18382 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
OPTIMUM NOISE PERFORMANCE OF MULTITERMINAL AMPLIFIERS
William D. Rummler (Ph.D. Thesis) 1 Feb. 1964 129 p refs
(Contract DA-36-039-AMC-03200(E); Contract DA-SIG-36-039-61-G14)
(Tech. Rept. 417; AD-434781)

Optimum performance is achieved with a multiterminal-pair source in a narrow band of frequencies Δf at a single-output terminal pair. The optimum noise performance of such a system is defined as the maximum signal-to-noise ratio achievable at large exchangeable signal power. It is shown that this is a meaningful criterion for any system that is to deliver ultimately an amount of signal power considerably greater than $kT_0\Delta f$, the noise power available from a resistor at a temperature T_0. The techniques described can be used, however, to determine the maximum signal-to-noise ratio achievable at any value of exchangeable (or available) signal power. The results are presented in a plot with noise-to-signal ratio and the reciprocal of exchangeable signal power

as coordinates—the noise-performance plane. The noise figure, exchangeable-power gain, and noise measure are given a geometrical interpretation in this plane. Definitions are given for the noise figure, exchangeable-power gain, and noise measure of a multiterminal-pair amplifier used with a multiterminal-pair source. The optimization procedure is extended to multifrequency networks coupled in an arbitrary manner by a lossless nonlinear device that obeys the Manley–Rowe formulas. Author

N64-18386 Air Force Cambridge Research Labs., Bedford, Mass. Electromagnetic Radiation Lab.
BACKFIRE ANTENNAS FOR SHF, UHF, AND VHF BANDS
J. A. Strom and H. W. Ehrenspeck Apr. 1963 25 p refs
(AFCRL-63-114; AD-406095)

The application of the backfire principle to endfire antennas increases their gain by 4 to 6 db over that of the original gain-maximized array. This report describes basic investigations on a 9,080-mc backfire antenna that was converted from an optimized Yagi antenna. Backfire antenna models have also been successfully tested at frequencies of 3,000, 600, and 220 mc. The design procedure and physical dimensions are given for all models. In addition, a method for building backfire antennas with gain figures up to 25 db is discussed. Author

N64-18438* ITT Corp., Easton, Pa. ITT Electron Tube Div.
DEVELOPMENT OF ELECTRONICALLY-TUNABLE CONVERTERS IN THE MILLIMETER-WAVE RANGE Bimonthly Report No. 4, 16 Jan.-16 Mar. 1964
R. W. Wilmarth and R. J. Kenyon [1964] 7 p
(NASA Contract NASw-790)
(NASA CR-53585) OTS: $1.10 ph

The current program status includes the following: (1) Essential work connected with the investigation of the intermediate-frequency effect on the conversion gain of a single-circuit converter, and with the experimental determination of the characteristics of ridge-loaded, meanderline circuits, partially or totally wrapped into a circular configuration, was completed. (2) The slow-wave structure for the backward-wave tubes, in the 50- to 75-gc range, suitable for operating a single-circuit converter and three double-circuited experimental backward-wave converters was chosen. The design of the structure was based on a series of calculations involving beam and circuit diameters, and on the results of measurements on cold test structures that bracketed the design. (3) An electron gun, to be used in connection with the double-circuited backward wave converter, was designed and parts were ordered for test. This is a low-noise gun that differs from the ordinary type of low-noise gun in that it must operate over an extended voltage range, as dictated by the tuning characteristics of the slow-wave circuit. I.v.L.

N64-18443* RAND Corp., Santa Monica, Calif.
"ISOTROPIC" COVERAGE ON SATELLITES OF LARGE DIAMETER AS COMPARED WITH WAVELENGTH
N. E. Feldman Aug. 1963 40 p refs
(NASA Contract NASr-21)
(NASA CR-53582; RM-3770-NASA) OTS: $3.60 ph

This memorandum describes techniques for achieving antenna broad angle coverage. The first method involves extending an antenna on a long mast. A biconical antenna is used that provides omnidirectional coverage (360 deg in azimuth) above −1 db relative to isotropic, over 90 percent or more of the surrounding space. The second method uses two extended balanced logarithmic conical spiral antenna elements, diametrically opposite and circularly polarized in the opposite sense as seen by an observer in the far field to provide "isotropic" (constant power over a sphere although of variable polarization) coverage. Coverage over 100 percent of the surrounding space appears achievable with a gain of −3 db relative to isotropic. The third method uses frequency diversity techniques. A number of alternatives are described providing either 100 percent coverage, or coverage in the direction of the ground-receiving terminal by selecting one of two half-wave antennas. Author

N64-18469 National Research Council of Canada, Ottawa Radio and Electrical Engineering Div
RADIATION PATTERNS OF BLACK BRANT II ANTENNA SYSTEMS
J. H. Craven Nov. 1963 17 p refs
(ERB-659)

The radiation patterns of a number of different possible telemetry antenna systems for Black Brant II rockets were measured to compare their performance. Measurements were made by means of a one-eighth scale model of the rocket. Configurations included different arrangements of blade, quadraloop, and suppressed quadraloop antennas. Author

N64-18506 Bureau of Mines, Rolla, Mo.
CONSTRUCTION AND OPERATION OF A QUARTZ COMPOSITE OSCILLATOR
A. E. Schwaneke 1964 24 p refs
(BM-RI-6419)

Plans and specifications are given for constructing a quartz composite oscillator designed to measure internal friction in metals and alloys. The characteristics of the system are listed, and detailed procedures for its operation are explained. Typical measurements on manganese–copper alloy, on single-crystal magnesium, and on polycrystalline magnesium are shown to illustrate applications of the system. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see:* 06 Auxiliary Systems.

N64-18149 Aeronautical Research Inst. of Sweden, Stockholm
SPEED AND SAFETY IN CIVIL AVIATION. PART III: SPEED VERSUS SAFETY; CONCLUDING REMARKS, DISCUSSION, THE 3RD DANIEL AND FLORENCE GUGGENHEIM MEMORIAL LECTURE
Bo K. O. Lundberg 1964 53 p refs Presented at the 3d Intern. Cong. of the Aeron. Sci., Stockholm, 27–31 Aug. 1962
(FFA-96)

The relationship between subsonic and supersonic flight and aviation safety is discussed in general. In particular, the following are discussed: (1) the flight safety of the supersonic transport (SST) and its operation—structural safety of aerodynamically heated structures and operational safety at supersonic speeds; (2) the influence of the operation of SST's on the flight safety of subsonic aviation; (3) effects of sonic booms; and (4) cosmic-radiation dangers resulting from the use of

SST's. It is concluded that the SST would be a cripple in the family of civil aircraft, and that supersonic aviation, as it is at present conceived, would be economically infeasible if judged by normal commercial criteria of profitability, even without taking into account the adverse economical consequences of the sonic boom and cosmic radiation. P.V.E.

N64-18152 Aeronautical Research Council (Gt. Brit.)
A FLIGHT STUDY OF THE SIDESTEP MANOEUVRE DURING LANDING
D. H. Perry, W. G. A. Port, and J. C. Morrall London, HMSO, 1964 53 p refs
(ARC-R&M-3347; supersedes RAE-AERO-2654, ARC-23433) HMSO: £1

Flight measurements have been made of two types of maneuver that might be used to correct lateral errors occurring at the end of an instrument approach. These are the true banked coordinated S turn and the sideslipping turn with wings held level. The tests showed the true banked S turn to be the more effective method. Measurements on 14 aircraft showed that at least 10 sec might be needed to make corrections from quite small displacements, even with a very maneuverable aircraft. A simple theoretical analysis, which supported this conclusion, also allowed the minimum practical maneuver time for any initial displacement to be calculated once the available rate of roll and an overriding maximum angle of bank had been established. Author

N64-18159* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MAN-MACHINE SYSTEM SIMULATION FOR FLIGHT VEHICLES
Steven E. Belsley Repr. from IEEE Transl. Profess. Group Human Factors in Electron. v. HFE-4, no. 1, Sep. 1963 p 4–14 refs

A procedure for conducting a meaningful simulation of a man–machine system is presented and illustrated by various specific examples. The relationship of the various types of simulators to their use is outlined, and desirable detailed characteristics are delineated. The tradeoffs between simulator complexity, realism, and the interrelation of various feedback sensing cues (motion, visual, or tactile) are discussed, and the necessity of validating the simulation by use of a variable stability and variable control system aircraft is noted. It is shown that as the problem to be studied becomes more complicated or the questions asked of the simulation become more quantitative, the simulator characteristics must become more flightlike. Author

N64-18223 Aerospace Corp., El Segundo, Calif. Satellite Systems Div.
A SYSTEMATIC APPROACH TO THE CHOICE OF STATION LOCATIONS FOR LOW-ALTITUDE SATELLITE TRACKING IN NEAR EQUATORIAL ORBITS
G. J. Bonelle 10 Mar. 1964 35 p ref
(Contract AF 04(695)-269)
(SSD-TDR-64-27; TDR-269(4110-01)-16; AD-433753)

This paper is primarily concerned with methods of choosing optimum locations for tracking stations that provide maximum support for satellites with near equatorial orbits. The method chosen makes use of the considerations that the orbit ground traces are concentrated in the vicinity of the latitude equal to the maximum inclination of the orbit and that most of the direct launchings possible from Cape Kennedy will have a very limited range of orbit inclinations; i.e., from 28 1/2° to 34 1/2°. The relative merits of the sites being considered using this method are then tested using the following criteria: (1) that a maximum number of tracking passes per day be supported, (2) that a minimum number of gaps exist in network coverage, (3) that stations provide early orbit support, and (4) that maximum support be given for recovery phases of satellite missions. Author

N64-18247 Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab.
SITING
R. M. Dohoo *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 7 p refs (See N64-18241 10-08)

The factors affecting the siting of a ground terminal are considered under the following headings: (1) freedom from radio noise; (2) maximum satellite visibility; (3) accessibility to switching centers; (4) meteorological conditions; (5) size of site; (6) accessibility to laboratory; (7) staff accommodations; and (8) cost of development. For both operations and experimental terminals, it is desirable that a site, with minimum manmade noise, be chosen. The following general points are felt to be important in the selection of a site: (1) The site should be as far as possible from radar, navigational, and microwave communications-systems installations. (2) The site should not be close to large centers of population or industry, although manmade industrial noise is relatively low at frequencies above 2 gc/s. (3) The site should be remote from airfield and busy air routes. (4) The site should be surrounded by hills to reduce the near-horizontal direct signals from sources of interference. R.T.K.

N64-18488 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W.Germany) Inst. für Angewandte Gasdynamik
THE SUBSONIC WIND TUNNEL OF THE DVL AT PORZ-WAHN [DER UNTERSCHALLWINDKANAL DER DVL IN PORZ-WAHN]
Gerhard Schulz Dec. 1963 51 p refs In GERMAN
(DVL-344) Available from Vereinigte Universitäts-u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

A new subsonic wind tunnel is equipped with a closed air conduct (Göttingen or Prandtl type). The test section has a cross section of about 7 m^2 and free boundaries. The maximum speed is 80 m/sec. The contraction ratio of the nozzle is 10:1; because of this, the turbulence is dropped, and the demanded drive power is considerably reduced. The pressure drop coefficient of the tunnel is therefore rather low. The settling chamber can be used as a second test section of large dimension (70 m^2) and small velocity. An automatic 6-component balance system is provided for the measurement of the air forces and moments. The balance attains an accuracy of 0.02%. Two asynchronous motors run the fan arbitrarily. The airspeed is chosen within a region by taking one of the three numbers of revolution of the fan and is then adjusted exactly by the pitch of the fan vanes. Author

N64-18508* Fairchild Stratos Corp., Wyandanch, N.Y. Electronic Systems Div.
AUTOMATIC PICTURE TRANSMISSION GROUND STATION. INSTALLATION, OPERATION AND MAINTENANCE MANUAL
Greenbelt, Md., NASA, Goddard Space Flight Center, 15 Mar. 1963 314 p
(NASA Contract NAS5-2870)
(NASA CR-53594) OTS: $19.75 ph

The Automatic Picture Transmission Ground Station (APTGS) provides facsimile reproductions of pictures transmitted from an orbiting meteorological satellite. The pictures, in the form of video signals, are received from the camera subsystem in the satellite while the satellite is circularly orbiting

the earth at a distance of 600 nmi, nominal. The APTGS will acquire the signals from the satellite when the satellite is more than 10° above the horizon of the receiving station and when the direction antenna is oriented to the satellite position. The recorder reconstitutes the transmitted picture on a line-by-line scan basis. The line-by-line scan of the total picture previously taken and stored by the camera subsystem is transmitted and reproduced by the recorder in 200 sec. The reconstituted pictures printed by the recorder are a clear, gray-shade reproduction of the transmitted picture. P.V.E.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-17855 Stanford U., Calif. Thermosciences Div.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF THE PLANE, INCOMPRESSIBLE, TURBULENT FREE SHEAR LAYER WITH ARBITRARY VELOCITY RATIO AND PRESSURE GRADIENT
C. M. Sabin. Oct. 1963. 122 p. refs
(AF AFOSR Grant 136-63)
(MD-9; AFOSR-TN-5443; AD-430120)

A first-order approximation is derived in similarity coordinates for the velocity variation across a mixing zone between two streams of different velocities in an arbitrary pressure gradient. The velocity profiles obtained are functions of a single parameter, the ratio of the velocity of the slow stream to that of the fast stream. The first-order velocity profiles are compared to those obtained from the complete solution to the zero-pressure-gradient case by Görtler, and good agreement is found when the velocity ratio is greater than 0.5. The form of the eddy diffusivity appropriate to the first-order theory is determined from analysis and experimental data. Expressions for the shear and the mixing layer width for the general case are presented, and shown to check the data from several cases. A hot-wire anemometer that was specially designed and constructed for taking the experimental data in a water channel is described. Author

N64-17860 Aberdeen Proving Ground, Md. Ballistic Research Labs.
THE UNSTEADY FLOW WITHIN A SPINNING CYLINDER
E. H. Wedemeyer. Oct. 1963. 30 p. refs
(BRL-1225; AD-431846)

A theoretical analysis is given of the unsteady flow within a liquid-filled cylinder of finite length, which is started impulsively to spin about its axis. It is established that a secondary flow, which is caused by the cylinder ends, has a remarkable effect on the generation of spin in the liquid. The theoretical results are compared with experimental observations, and good agreement is found. Author

N64-17994* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WALL-PRESSURE FLUCTUATIONS AND PRESSURE-VELOCITY CORRELATIONS IN A TURBULENT BOUNDARY LAYER
John S. Serafini (Ph.D. Thesis—Case Inst. of Tech., Jun. 1962). Washington, NASA, Dec. 1963. 81 p. refs
(NASA TR R-165) OTS: $2.00

All measurements were made at a nominal free-stream Mach number of 0.6 and an average Reynolds number per foot of 3.45×10^6 in a wind-tunnel facility specially designed for the purpose. The root-mean-square magnitudes of the wall-pressure fluctuations agree with the Lilley–Hodgson theoretical results, whereas the mean-square spectra do not agree except over a small range of frequencies. Space–time correlations of the wall-pressure fluctuations generally agree with Willmarth's experimental results for longitudinal separation distances. Measurements of lateral space–time correlations indicated that the ratio of the longitudinal to lateral length scale is approximately 7.4. The convection velocity of the fluctuations is found to increase with increasing separation distances, and its significance is explained. Measurements of the correlations of the wall-pressure fluctuations with the longitudinal component of the velocity fluctuations indicate that the contributions to the wall-pressure fluctuations are from two regions, an inner region near the wall and an outer region linked with the intermittency. Author

N64-18019 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
RESEARCH ON HYPERSONIC FLOW Final Report, 15 Dec. 1960–15 Dec. 1963
H. F. Waldron, C. E. Wittliff, and M. R. Wilson. Wright-Patterson AFB, Ohio, Aerospace Res. Labs., 1964. 45 p. refs
(Contract AF 33(616)-7812)
(ARL-64-27; AD-433737) OTS: $1.25

The theoretical and experimental investigations have been concerned with three aspects of hypersonic flow; namely, rarefied hypersonic flow about blunt axisymmetric bodies, about cylinders normal to and inclined to the free stream, and higher Reynolds number flows about pointed cones. Author

N64-18046 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
AN EXPERIMENTAL STUDY OF SECONDARY FLOW IN JET-DRIVEN VORTEX CHAMBERS General Research
D. H. Ross. 27 Jan. 1964. 56 p. refs
(ATN-64(9227)-1; AD-433052)

The characteristics of vortex flows in enclosed chambers are strongly influenced by the existence of three-dimensional secondary flows in the end-wall boundary layers and in a region near the axis. A series of flow visualization experiments was conducted to obtain a qualitative picture of the flow and the effects of changes in geometry and flow parameters. A transparent vortex chamber and selective dye injection into the water-working fluid were utilized. Interest centered on changes in the surface and shape of the end walls and on the exit hole. A form of end-wall-boundary-layer slot blowing was effective in altering the secondary flow pattern. An approximate analysis is made to determine the effect of nonplanar end-walls on boundary-layer radial mass flow. Author

N64-18049 Aeronautical Research Associates of Princeton, Inc., N.J.
EXAMINATION OF THE SOLUTIONS OF THE NAVIER-STOKES EQUATIONS FOR A CLASS OF THREE-DIMENSIONAL VORTICES. PART III: TEMPERATURE DISTRIBUTIONS FOR STEADY MOTION
Coleman duP. Donaldson and Roger D. Sullivan Nov. 1963 27 p refs
(Contract AF 49(638)-255)
(AFOSR TN-60-1227; ARAP-51; AD-433736)

The temperature distributions that occur inside a steadily rotated cylindrical vortex tube with porous walls having steady radial inflow of an essentially incompressible fluid are obtained. The nature of the distributions for both liquids and gases is discussed. The results are compared with Rott's results for Burgers' unbounded vortex. Author

N64-18134* Lockheed California Co., Burbank
Eighth Monthly Progress Report, 1-31 Jan. 1964 [COMPUTER PROGRAM PREDICTING HYPERSONIC AIRCRAFT PROPULSION SYSTEMS INTERNAL FLOWS]
[1964] 14 p refs
(NASA Contract NAS2-1460)
(NASA CR-53397) OTS: $1.60 ph,

Major emphasis was placed on dividing the combined computer program into four main programs, continuing checkout of the routines, and finalizing the boundary-layer routines. The four computer programs are: (1) the external-flow program which computes the complete viscous–inviscid flow field up to the cowl shock wave; (2) the blunt cowl-lip program, which computes the flow field around the blunted cowl lip, using the Ames blunt-body program and the boundary-layer routine; (3) the internal flow (with no shock intersections) program that computes the flow field downstream of the cowl-lip shock to any shock intersections; and (4) the internal flow (with shock intersections) program that computes the flow field downstream of the first shock intersection to the end of the inlet. I.v.L.

N64-18195 Hydronautics, Inc., Laurel, Md.
MOTIONS OF TILT FLOAT VEHICLES IN WAVES
Roderick A. Barr and Milton Martin Oct. 1963 172 p refs
(Contract N600(19)-58363)
(Tech. Rept. 237-1; AD-434163)

The nonlinear equations of motion for the heave, pitch (or roll), and surge (or sway) motion of a tilt-float supported amphibious vehicle drifting in a seaway are derived. These equations are programed for an IBM 7090 electronic digital computer, and the results are presented of computations, which show the effect of various parameters on the heave and pitch response to waves of all significant frequencies contained in a seaway. The principal parameters investigated are the effects of the slenderness ratio of the floats, the vertical elevation of the c.g. of the vehicle, the radius of gyration of the vehicle, the cant angle of the floats, vertical and horizontal damping plates, the geometric arrangement of the floats, and the wave height (nonlinear effect). Author

N64-18325 Aeronautical Research Council (Gt. Brit.)
TWO-DIMENSIONAL SEPARATED OR CAVITATING FLOW PAST A FLAT PLATE NORMAL TO THE STREAM
G. E. Gadd (Natl. Phys. Lab.) London, HMSO, 1963 39 p refs
(ARC-CP-697; supersedes NPL-SD-38, ARC-24247)

The applicability of inviscid-flow models to noncavitating or cavitating flow past a normal plate is discussed. A new inviscid model is developed, with the aim of predicting features, such as cavity length, better than previous models. Experiments on airflow past a plate are described, and the results compared with those of the theory. The few experimental results available for cavitating flow are discussed. Author

N64-18327 Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS OF SKIN-FRICTION USING SURFACE-PITOT TUBES IN FREE FLIGHT AT SUPERSONIC SPEEDS
J. B. W. Edwards London, HMSO, 1964 32 p refs
(ARC-CP-711; supersedes RAE-TN-AERO-2891, ARC-24715)
HMSO: 6s

Surface pitot tubes have been used to measure local skin friction in free flight. Measurements were made at 10 stations on a simple delta-winged model flying at zero lift at Mach numbers between 2.2 and 1.2. This note describes the design and development of the instrumentation and the methods employed to analyze the experimental data. Good agreement between the measured and estimated values of skin friction exists over most of the Mach number range. Author

N64-18360 Naval Ordnance Lab., White Oak, Md.
TRANSIENT AND SINUSOIDAL THERMAL DIFFUSION, CONVECTION, AND RELATED INFRASONIC PRESSURE CHANGES IN ENCLOSED FLUIDS
H. Gerber 10 Oct. 1963 376 p refs
(NOLTR-62-94; AD-431568)

The topics discussed include: (1) basic heat-transfer processes; (2) the transmission of heat through walls; (3) numerical relationships between temperature changes and corresponding pressure changes; (4) infrasonic acoustic impedances and infrasonic pressure changes of enclosed gases due to sinusoidal and transient excitation in the presence of thermal diffusion; (5) experimental measurements, including descriptions of some basic experiments and the results obtained; (6) changes of average temperature and infrasonic pressure of enclosed gases due to transient and sinusoidal excitation, in the presence of thermal diffusion and convection; and (7) general design considerations, involving the use of enclosed fluids at infrasonic frequencies. R.T.K.

N64-18362 Avco Corp., Wilmington, Mass.
EFFECTS OF NONEQUILIBRIUM ON THE HYPERSONIC LAMINAR BOUNDARY LAYER
P. De Rienzo, A. D. Wood, F. Berner, and J. D. Teare (Avco-Everett Res. Lab.) 31 Jan. 1964 37 p refs
(Contract AF 04(694)-239; Contract AF 04(694)-33)
(RR-171; RAD-TM-64-2; AD-429808)

An approximate method is formulated for the determination of the nonequilibrium, compressible, laminar boundary layer, both with and without the restriction of vibrational equilibrium. The method involves solution of the rate equations for species production and vibrational relaxation along effective particle paths determined from mass continuity considerations. The velocity and enthalpy time histories along these paths are then specified from the appropriate locally similar equilibrium or frozen boundary-layer analyses. Application of the method is illustrated for the hypersonic laminar boundary layer along a sharp cone. Results are compared with more exact numerical solutions of the nonequilibrium boundary-layer equations, and the limitations of the approximate method are indicated. The technique is used to determine the effects of altitude and cone angle on the nonequilibrium boundary layer, together with the influence of variations in the chemical rate constants and vibrational relaxation models. The application of binary scaling is discussed. Author

N64-18378 Wisconsin U., Madison. Mathematics Research Center
AN EXACT ANALYSIS OF LAMINAR FLOW IN THE ENTRANCE REGION OF AN ANNULAR PIPE Technical Summary Report
R. Manohar. Jan. 1964. 20 p. refs
(Contract DA-11-022-ORD-2059)
(MRC-477; AD-433880)

Nonlinear equations of laminar flow of a viscous incompressible fluid in the entrance region of an annular pipe have been solved by an exact method. It is assumed that the velocity of the fluid is uniform at the entrance section. Velocity profiles, pressure distribution, and inlet lengths have been obtained for various values of the ratio of inner and outer radii of the pipe. Author

N64-18467 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
ON THE STABILITY OF A LAMINAR BOUNDARY LAYER FOR A MAXWELLIAN FLUID
K. S. Wen. Dec. 1963. 32 p. refs
(R63SD102)

It has been discovered that certain non-Newtonian fluid stabilizes the laminar boundary layer significantly. The present investigation is a preliminary effort toward the understanding of the mechanism behind this unusual phenomenon. The fluid model chosen is that of a Maxwellian fluid the mechanical property of which is characterized by a relaxation time. The stability of a laminar boundary layer is then considered. It is found qualitatively that the minimum critical Reynolds number is smaller than that in the Newtonian case and decreases with increasing relaxation time. Therefore, the boundary layer will become more unstable compared with the Newtonian case. However, the results of this investigation point toward another fluid model that possesses a highly stabilizing characteristic. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-17854 Geophysics Corp. of America, Bedford, Mass.
A NEW METHOD FOR ATMOSPHERIC TEMPERATURE DETERMINATION Scientific Report No. 3
Raymond A. Minzner, Gerhard Sauermann, and Lennart R. Peterson. Jun. 1963. 117 p. refs
(Contract AF 19(628)-1633)
(GCA-TR-63-9-A; AFCRL-63-661; AD-427618)

Number-density versus altitude data for two gases having large differences in molecular weight permit the accurate determination of the temperature of planetary atmospheres in diffusive equilibrium. A well-known equation relating temperature and number density of a single gas, when applied alternately to the heavy and light gases, determines a temperature–altitude profile with associated uncertainties that are minimized by an iterative process. A new equation simultaneously involving both the light- and heavy-gas number densities permits accurate temperature calculations in a single-step process. This dual-gas equation applied to the upper half of a region of observed number-density data, together with the heavy-gas-down equation applied to the lower half of the region, provides a minimum-error, temperature–altitude profile over the entire altitude range of number-density data. The earth's atmosphere characterized by the 1962 standard atmosphere serves as a numerical example. Author

N64-17859 Instituto Geofisico Del Peru, Huancayo
MEASUREMENTS OF THE NIGHT SKY RADIATIONS AT THE MAGNETIC EQUATOR, HUANCAYO, PERU Final Technical Report, 1958–1962
Mateo Casaverde and Alberto Giesecke. Oct. 1963. 16 p. refs
(Contract AF 19(604)-7213)
(AFCRL-63-736; AD-430957)

Essentially the main effort has been to carry out a continuous and reliable program of night sky observations at Huancayo, Peru, in the magnetic equatorial region. Observations were made with a scanning photometer, at various azimuths and altitudes all over the sky, on three wavelengths—6,300 A, 5,893 A, and 5,577 A. Data analysis and correlation with other geophysical parameters are reported. Author

N64-17861 Harvard Coll. Observatory, Cambridge, Mass.
IONOSPHERIC FOCUSING IN THE PRESENCE OF THE EARTH'S MAGNETIC FIELD Technical Report No. 5
Michael D. Papagiannis and G. Richard Huguenin. Oct. 1963. 28 p. refs
(Contract AF 19(604)-6120)
(ARCRL-63-945; AD-431004)

A new technique has been developed for application to problems of radio wave propagation in magnetoionic media. This method is based on a mathematical formulation of Poeverlein's graphical solution. The mathematical formulation is made possible by assuming that the index of refraction surfaces are ellipsoids of revolution. Solutions of complicated problems can be obtained in terms of the semiaxes, a and b, of these ellipsoids, which can be evaluated as continuously varying elements by use of the Appleton–Hartree equation. The problem of focusing in the terrestrial ionosphere has been investigated in complete generality through an application of this new technique. The general equations obtained have the same structure as those previously derived by neglecting the terrestrial magnetic field. The corresponding radiation patterns are substantially different, however, when the effects of the earth's magnetic field are included. Author

N64-17862 Block Engineering, Inc., Cambridge, Mass.
INFRARED HORIZON STUDIES Final Report
Merle J. Persky. 31 Dec. 1963. 17 p. ref
(Contract AF 19(628)-2946)
(AFCRL-64-210; AD-430887)

A high-altitude balloon flight to gather data of the earth's infrared horizon is described. Author

N64-17919 Pennsylvania State U., University Park, Ionosphere Research Lab.
THE IONOSPHERIC CONDITIONS

Marcel Nicalet and William Swider, Jr. 10 Sep. 1963 54 p refs
(Contract AF 19(604)-4563; Contract DASA-WEB-07.010; NSF Grant G-18983)
(Sci. Rept. 193; AFCRL-63-834; AD-417236)

A general analysis of ionospheric conditions has been made in the light of possible ionic reactions occurring in the upper atmosphere. The ionic complexity of the ionosphere is underlined by describing how the atomic ions O^+ and N^+ react with N_2, O_2, and NO molecules. The behavior of the molecular ions N_2^+, O_2^+, and NO^+ depends on a group of simultaneous processes involving charge transfers and ion–atom interchanges, which are more important than dissociative recombinations. The altitude distribution of ions is exemplified by discussing the relative importance of various loss coefficients in the D, E, and F regions. It is seen that molecular nitrogen ions are subject to important charge transfer processes and that nitric oxide ions are always final products, destroyed only by dissociative recombination. Additionally, the entire production of atomic oxygen ions is related to the photoionization of molecular nitrogen. Some information is also given on possible anomalies in the ratio O_2^+ and NO^+ densities in the lower ionosphere. Author

N64-17975 Joint Publications Research Service, Washington, D.C.
RAPID PULSATIONS OF THE EARTH'S ELECTROMAGNETIC FIELD AND PROCESSES IN THE UPPER ATMOSPHERE
V. A. Troitskaya 8 Apr. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk. SSSR (Moscow), no. 1, 1964 p 22–25
(JPRS-24085; OTS-64-31014) OTS: $0.50

The International Geophysical Year and the years that followed were a period of brisk development of work on short-period pulsations. These rapid field changes were investigated systematically in both polar regions, and studies were made of pulsations with periods less than 15 sec. An analysis was made of the relationship between different types of short-period pulsations and a complex of electromagnetic phenomena in the upper atmosphere. It was found that high-level nuclear explosions are accompanied by the excitation of characteristic rapid changes of the magnetic field and earth currents. It was possible to detect earlier unknown correlations between rapid variations of the electromagnetic field and processes in the upper atmosphere. Information on short-period pulsations was found to be quite necessary for practical work involved in the study of the structure of the earth's crust and exploration for minerals. P.V.E.

N64-18042 Army Signal Research and Development Lab., Fort Monmouth, N.J.
CONVERSION OF TOPSIDE IONOGRAMS TO EXPONENTIAL ELECTRON-DENSITY PROFILES
P. R. Arendt and A. Papayonaou 3 Feb. 1964 21 p refs
(USAELRDL-TR-2424; AD-433210)

Ionograms obtained from the Alouette Satellite suggest that above the F_2-layer the electron-density profile is an exponential or quasi-exponential function. This concept of electron distribution is used in reducing the ionograms to true-height profiles. The reduction yields the distribution as well as the altitude variation of the exponential function. Author

N64-18081* Johns Hopkins U., Baltimore, Md.
AN OBSERVATION OF THE (O,O) NEGATIVE BAND OF N_2^+ IN THE DAYGLOW
E. C. Zipf, Jr., and W. G. Fastie Washington, NASA, Apr. 1964 10 p refs
(NASA Grant NsG-193-62)
(NASA TN D-2249) OTS: $0.50

The observations discussed represent results of the blue (3914 A) photometer experiment obtained May 7, 1963, from an Aerobee Hi rocket launching at Wallops Island, Virginia. Density data and photo ionization rates and loss frequencies for N_2^+ are tabulated for altitudes from approximately 140 to 220 km. Author

N64-18121* Rensselaer Polytechnic Inst., Troy, N.Y.
FUNDAMENTAL ATOM CHEMISTRY WITH APPLICATIONS TO THE CHEMISTRY OF THE UPPER ATMOSPHERE Technical Status Report No. 5, 1 Jul. 1963–31 Dec. 1963
P. Harteck, R. R. Reeves, Jr., and E. W. Albers [1963] 2 p
(NASA Grant NsG-158-61; RPI Proj. 441.61)
(NASA CR-53424) OTS: $1.10 ph

Investigation of the nitrogen system has continued using N_2^{14-14} and N_2^{15-15} under various conditions. A small change was observed in the nitrogen system conversion at 1.5° K. The conversion of tritium in the heat conductivity cell appears to occur exclusively via a wall catalysis; increasing the wall surface by a factor of five resulted in a fivefold increase in the conversion rate. The half-lifetime for the conversion in the solid phase with varying amounts of hydrogen present (5% to 50% hydrogen) varies linearly with the hydrogen content. The conversion of both isotopes in the solid phase has been measured simultaneously. Whereas the tritium half-lifetime increases with increasing amounts of hydrogen, the hydrogen half-lifetime decreases substantially. R.T.K.

N64-18160* Stanford U., Calif. Radioscience Lab.
A COMPARISON OF METHODS USED FOR OBTAINING ELECTRON CONTENT FROM SATELLITE OBSERVATIONS
O. K. Garriott and F. de Mendonca (Brazil. Comissao Nacl. de Atividades Espaciais) Repr. from J. Geophys. Res., v. 68, no. 17, 1 Sep. 1963 p 4917–4927 refs
(NASA Grant NsG-30-60)

Measurements of the effects of the ionosphere on the polarization and the Doppler shift of radio transmissions from earth satellites permit the electron content of the ionosphere to be calculated. Thirty-five passages of Transit 2A have been analyzed in a variety of ways to estimate the accuracy of the several methods. The most accurate method is a hybrid analysis using both Faraday and Doppler data simultaneously. Methods based on the rate of polarization rotation, on the number of rotations between two times, and on best-fitting polynomials to either the Faraday or the Doppler data are compared and their errors estimated. Author

N64-18164* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROPOSED SOLUTION TO THE GEOMAGNETIC ANOMALIES IN THE IONOSPHERE
William T. Roberts Washington, NASA, 24 Sep. 1963 37 p refs
(NASA TM X-53003) OTS: $3.60 ph

In order to determine the driving and controlling mechanisms that predominate in the ionosphere, a series of contour maps were drawn from IGY data taken at stations lying approximately along the 75th meridian. An attempt was then made to interpret the anomalous behavior of the F_2 peak of the ionosphere in the vicinity of the geomagnetic equator. If it is assumed that there exists an equatorial electrojet and that the magnetic field that is associated with this electrojet is sufficient to perturb the earth's main magnetic field, electrons may

be deflected away from the geomagnetic equator. Furthermore, if the atmosphere tends to expand and contract diurnally, ions and electrons may be deflected into regions at times that could account for the nocturnal increase in electron density north and south of the geomagnetic equator. Author

N64-18171* RAND Corp., Santa Monica, Calif.
ANALYSIS OF SURFACE MAGNETIC FIELDS BY INTEGRALS
A. B. Kahle and E. H. Vestine Jul. 1963 33 p refs
(NASA Contract NASr-21(05))
(NASA CR-53470; RM-3637-NASA) OTS: $3.60 ph

The method of field analysis by integrals is developed and applied, with an electronic computer, to various test fields prescribed over the surface of a sphere. The results are compared with the true values, and a scheme of numerical integration is devised to insure suitable accuracy. Finally, this method is successfully applied to the geographical distribution of the daily mean field of disturbance. The part of the observed surface field that is of external origin is isolated, and atmospheric current functions capable of yielding it are derived. Author

N64-18268 Measurement Analysis Corp., Los Angeles, Calif.
PREDICTION OF TIME SERIES USING MULTIPLE REGRESSION TECHNIQUES AND SEAKEEPING APPLICATIONS
Loren D. Enochson Dec. 1963 39 p refs
(Contract Nonr-4305(00))
(MAC-307-01; AD-432475)

This report discusses methods for predicting future values of discrete time series from past observed values of the time series. The points at which the autocorrelation function is computed are the past points used in the analysis. Classical ideas are reviewed, and then extended to handle more advanced time-series problems. Applications of these results are explained for seakeeping applications of: (1) long-range ocean activity prediction; (2) short-term roll prediction; and (3) vibration-response prediction. Further material appears on statistical tests for coefficient determination, and on digital computer requirements. Author

N64-18300* RAND Corp., Santa Monica, Calif.
ULTRAVIOLET SPECTROSCOPY OF THE UPPER ATMOSPHERE. PART I OF AN EXAMINATION OF THE APPLICATION TO SATELLITE METEOROLOGY OF VARIOUS SEGMENTS OF THE ELECTROMAGNETIC SPECTRUM
R. O. Hundley Dec. 1963 51 p refs
(NASA Contract NASr-21(07))
(NASA CR-53508; RM-3950-NASA) OTS: $5.60 ph

The various physical and chemical processes involved in the interaction of radiation with the atoms and molecules of the upper atmosphere are reviewed. These include radiation absorption processes, such as photodissociation, photoionization, and resonance absorption; radiation scattering processes, such as Rayleigh scattering and resonance scattering; and radiation emission processes, such as chemiluminescence. The ultraviolet spectral features that result from these processes are summarized. These features include molecular absorption and emission bands, discrete atomic spectral lines, and atomic and molecular absorption continua. Various ways are discussed in which rocket and satellite observations of these spectral features can be used to study the composition of the upper atmosphere. Author

N64-18308 Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
THE WHISTLER-HYDROMAGNETIC EXTENSION OF MAGNETO-IONIC THEORY
Gideon Kantor (Ph. D. Thesis—Cornell U.) Dec. 1963 122 p refs
(AFCRL-63-929; AD-430051) OTS: $10.10

The whistler-hydromagnetic extension of magnetoionic theory is studied in detail, and includes derivations of exact and approximate expressions for the phase refractive index; computation of numerical values, considering protons; plots of standard curves, as well as refractive index surfaces; and plots of error curves for the approximations. Author

N64-18370 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
AN INTEGRATING AND A POLAR NEPHELOMETER FOR ATMOSPHERIC SCATTERING MEASUREMENTS IN THE ULTRAVIOLET
T. A. Jacobs and R. R. Giedt 17 Feb. 1964 21 p refs
(Contract AF 04(695)-269)
(TDR-269(4230-20)-5; SSD-TDR-64-12; AD-433111)

Integrating and polar nephelometers have been constructed for the measurement of atomospheric scattering as a function of wavelength and altitude. The instruments were designed particularly for the 3,000 to 3,800 A spectral region. Preliminary results are presented of field measurements covering altitudes from sea level to 11,000 ft. Author

N64-18372 Geophysics Corp. of America, Bedford, Mass.
CONSIDERATIONS ON ANALYSIS OF ATMOSPHERIC STRUCTURE DATA WITH EMPHASIS ON THE COMPUTATION OF THE ANGULAR DISTANCE FROM THE SUBSOLAR POINT Scientific Report No. 4
Lennart R. Peterson and Raymond A. Minzner Jan. 1964 19 p refs
(Contract AF 19(628)-1633)
(GCA-TR-64-1-A; AFCRL-64-232; AD-433641)

The equation derived for computing the angular distance from the subsolar point is:

$$\cos\ \alpha = \frac{\tan\gamma \sin\theta_L \sin\left[(N-80)\,360/365\right] - \cos\theta_L \cos(15\,t)}{\left\{1 + \tan^2\gamma \sin^2\left[(N-80)\,360/365\right]\right\}^{1/2}}$$

where α is the angular distance between the subsolar point and the zenith of the observation point, γ is the inclination of the earth's axis with respect to the orbital angular momentum vector ($\tan\gamma = .4336$), θ_L is the latitude of the observation point, t is time in hours past "apparent" midnight, and N is the number of days past December 31. In the derivation of this equation, spherical geometry was assumed throughout. The largest net effect of this assumption is that the time does not correspond to local standard time except on the average. Thus, to avoid errors in α of 5° to 10°, the correct values of time must be used. The parameter t (time) is seen to be a means for expressing the hour angle of the sun, with respect to the lower meridian of the observing site, and corresponds to what in astronomy would be called the local apparent time of the launch rocket rather than to the standard mean time t_{std}. Also, launch statistics and information on 35 rocket flights, involving atmospheric density measurements from 1946 to 1962, are presented. I.v.L.

N64-18408* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
SOME RESULTS OF A NEW METHOD FOR OBTAINING IONOSPHERIC N(h) PROFILES AND THEIR BEARING ON THE STRUCTURE OF THE LOWER F REGION

A. K. Paul (Ionosphären Inst., Breisach, W. Germany) and J. W. Wright Repr. from J. Geophys. Res., v. 68, no. 19, 1 Oct. 1963 p 5413–5420 refs
(Partially supported by NASA)

To be useful for studies of ionospheric processes, *N(h)* profiles must be obtainable from ionograms by methods that minimize uncertainties near the base and peak of the *F* region and that give the true shape of the profile with an accuracy commensurate with the available virtual height information. The principles of such a method are presented in which corrections are made for unobserved and "valley" parts of the profile; the method gives a good convergence to the true curvature of the profile in each interval. Examples show a sequence of profiles calculated through the sunrise period at a midlatitude station. The *E*-region valley is found to range between 40 and 150 km in width. Author

N64-18428* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies

THE SPACE DISTRIBUTION OF TRAPPED FISSION DEBRIS FROM THE HIGH ALTITUDE NUCLEAR TEST OF JULY 9, 1962

Raymond G. D'Arcy and Stirling A. Colgate (Lawrence Radiation Lab.) [1962] 15 p refs Presented at the Joint NASA-DASA Symp. on the Artificial Radiation Belt, held at the Goddard Space Flight Center, Greenbelt, Md., Sep. 10–11, 1962
(NASA Grant NsG-179-61; Contract AF 19(604)-4554)
(NASA CR-53592) OTS: $1.60 ph

A discussion is presented of an experiment that was performed to measure the absolute quantity and extent of the fission-product debris in the southern conjugate area from the July 9, 1962, high-altitude nuclear test. A gamma-ray spectrometer, installed aboard a KC-135 aircraft, was used in the experiment. The results obtained were used in the mapping of the fission-product debris in the Southern Hemisphere, in order to yield new information concerning the debris distribution in space at that time when the debris became trapped by the earth's magnetic field. I.v.L.

N64-18435* RAND Corp., Santa Monica, Calif.

Quarterly Status Report, 12 Sep.–11 Dec. 1963 [SCIENTIFIC UTILIZATION OF METEOROLOGICAL SATELLITE DATA AND THE IMPLICATIONS OF NEW TECHNIQUES AND MEASUREMENTS TO METEOROLOGICAL SATELLITE DEVELOPMENT]

Y. H. Katz 1963 2 p refs
(NASA Contract NASr-21(07))
(NASA CR-53587; AR-113-NASA) OTS: $1.10 ph

Research in pattern recognition was aimed at developing some mechanical procedure for automatically recognizing and classifying cloud patterns and with a capability comparable to that demonstrated by a consensus of trained meteorologists. In the first, or data reduction, stage tests are being made, and features that appear significant are being extracted in small collections of data. In the second, or decision process, stage the reduced data will become the arguments of a set of decision functions whose values will be used to provide a guess at an unknown pattern's identity. In addition to generating the two-dimensional autocorrelation functions for patterns containing cloud streets and individual cumulus cells, brightness distributions have been obtained and a possible class distinction, based on these distributions, has been noticed. Also, another motion-invariant datum is being investigated. This datum deals with allowing white (cloud) to overrun black (space) or black to overrun white for each pattern sample. I.v.L.

N64-18475* New Hampshire U., Durham

OBSERVATIONS OF SUDDEN IMPULSES IN THE MAGNETOSPHERE OBTAINED FROM EXPLORER XII DATA

Atsuhiro Nishida (Chicago U., Ill.) and Laurence J. Cahill, Jr. [1963] 32 p refs
(NASA Contract NASw-155; NSF Grant GP-797)
(NASA CR-53611; UNH-64-2) OTS: $3.60 ph

Explorer XII magnetic records show that a positive sudden impulse on the ground is accompanied by an increase in the field strength within the magnetosphere, and, hence, by a compression of the magnetosphere. Similarly, a negative sudden impulse on the ground is associated with a decrease in the field strength and an outward motion of the magnetospheric boundary. The speed of propagation of the field variations through the magnetosphere seems to be close to the hydromagnetic wave speed, although the ray theory is not applicable. Author

N64-18477* Massachusetts Inst. of Tech., Cambridge

EXPLORER X PLASMA MEASUREMENTS

A. Bonetti, H. S. Bridge, A. J. Lazarus, B. Rossi, and F. Scherb Vatican, Pontificia Acad. Sci., 1963 98 p refs Repr. from the book "Semaine d' Etude sur le Problème du rayonnement cosmique dans l' espace interplanetaire," p 61–157
(NASA Grant NsG-386)
(Pontificiae Acad. Sci. Scripta Varia, no. 25)

Plasma measurements were made with a detector aboard the Explorer X satellite, launched on a highly elongated elliptical trajectory with the line of apsides about 33° to the antisolar direction. Magnetic field measurements were also carried out. A plasma moving with a velocity of about 300 km sec^{-1} was first observed when the satellite reached a distance of about 22 earth radii. During the remainder of the observations (which terminated about 40 hours later, at a distance of 42 earth radii) periods in which substantial plasma fluxes were recorded alternated with shorter periods in which the plasma flux was below or just above the detection limit. There was a striking correlation between the plasma flux and the magnetic field; in the absence of plasma the magnetic field direction was nearly radial from the earth, whereas in the presence of plasma, the field was irregular and generally formed large angles with the earth-satellite direction. Author

N64-18480* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies

THE MAGNETOSPHERIC CUT-OFF FOR 1.5 MEV EXTRATERRESTRIAL PROTONS

C. Y. Fan, J. A. Simpson, and Edward C. Stone Feb. 1964 9 p refs Submitted for Publication
(NASA Grant NsG-179-61; Contract AF 19(628)-2473; AF AFOSR Grant 62-23)
(NASA CR-53180; EFINS-64-5) OTS: $1.10 ph

A study of the arrival of extraterrestrial low-energy protons over the geomagnetic polar regions is discussed. Measurements are presented from oriented satellites whose orbits passed over the geomagnetic pole carrying detectors sensitive to 1.5 Mev protons from both the vertical and horizontal directions and insensitive to electrons. It was found that protons of approximately 2 Mev arrive with full intensity down to a geomagnetic latitude of 65°. Data taken from a satellite in a low altitude (300 km) polar orbit show an abrupt transition between the low latitude background (mostly alpha particle events from uranium used to check instrument performance) and the solar proton flux, which is essentially constant over the entire polar region. It was also found that counting rates obtained by the various counters on the satellite were consistent with a flux that is isotropic over the upper hemisphere. The

transition in counting rate was found to be more abrupt for the side away from the sun (dark side) than for the sun side. The latitude at which full intensity is reached is ~5° higher on the sun side. P.V.E.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-17971 Joint Publications Research Service, Washington, D.C.

HEAT EXCHANGE IN THE MELTING OF ICE

A. G. Tkachev 3 Apr. 1964 9 p refs Transl. into ENGLISH of an article from the book "Ledotermicheskiye Vopr. v Gidroenergetike," Moscow, 1954 p 159–164

(JPRS-24019; OTS-64-21974) OTS: $0.50

Heat exchange in the melting of ice, both in its own fluid and in free-moving surrounding fluids, is investigated. The coefficient of heat transfer for horizontal cylinders of ice was found to have its lowest value at a surrounding water temperature of about 5° C, as was expected from considerations of water density at various temperatures. Results are plotted for horizontal cylinders in water, benzol, and ethylene glycol, vertical cylinders in water, and spheres in water. Comparisons of the regularity of the changes of the Nusseult criterion for free movement of fluid for the three ice shapes without change in aggregate composition show that, although the general regularity for heat exchange in melting is preserved, only the data for spheres coincide with values of heat exchange obtained using Mikheev's equation. The smaller values of the Nusseult criterion obtained for vertical and horizontal cylinders are explained by the formation of an additional sublayer of liquid at the surface of the floating body, which creates an additional thermal resistance. A hypothesis is presented stating that, in the process of freezing on the surface of a solid body, greater coefficients of heat transfer may be expected than in heat exchange without a change in aggregate composition. M.P.G.

N64-17985 Bureau of Mines, Berkeley, Calif.

HEAT OF FORMATION OF ALUMINUM CARBIDE

Alla D. Mah 1964 8 p refs

(BM-RI-6415)

The heat of combustion of aluminum carbide (Al_4C_3), obtained directly by combustion calorimetry, was $\Delta H_{298.15} = -1{,}029.6 \pm 1.9$ kcal/mole. The heat of formation of aluminum carbide corresponding to this value was $\Delta H_{298.15} = -53.4 \pm 2.0$ kcal/mole. Author

N64-17995* National Aeronautics and Space Administration, Washington, D.C.

SOLUTION OF HEAT CONDUCTION PROBLEMS BY THE GRID METHOD

G. F. Muchnik (USSR) Apr. 1964 18 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR (Minsk), v. 4, no. 3, 1961 p 72–82

(NASA TT F-151) OTS: $0.50

This paper examines the solution of heat conduction problems by the grid method, according to which the temperature at any point is expressed in terms of its values at the boundaries through the "coupling" coefficients or "weights." These coefficients express the relationship between an arbitrary point within the region and the points at the boundaries. The values of the "weights" are independent of the boundary conditions. The problem lies in the determination of these "weights." The method is compared with other methods. Author

N64-18011 Linde Co., Indianapolis, Ind. Speedway Research Lab.

DEVELOPMENT OF HIGH ENTHALPY, HIGH POWER ARC AIR HEATERS

R. J. Sarlitto, R. C. Eschenbach, D. A. Bryson, R. N. Laakaniemi, and H. H. Troue Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1964 85 p refs

(Contract AF 33(616)-8437)

(RTD-TDR-63-4055; AD-433212)

The enthalpy attainable at a given chamber pressure was more than doubled.; enthalpies of about 10,000 Btu/lb were obtained at 25 to 30 atmospheres, and about 4,000 Btu/lb at 90 to 100 atmospheres. Applicability of the scaling laws previously determined was shown to be valid in the higher enthalpy operating area now attainable, although with less precision than found before. Design of a 50-mw heater, to operate over a range of pressures and enthalpies, was satisfactorily completed. A 4-mw high-enthalpy heater was operated at 7,100 Btu/lb air enthalpy at 10 atmosphere chamber pressure at 1.8 mw with quite low erosion rate. Stable operation of a three-phase alternating current heater was achieved, although difficulties with seals limited satisfactory operation to modest enthalpies (3,500 to 5,500 Btu/lb) at pressures of 5 to 20 atmospheres. Effluent fluctuation measurements showed levels believed usable for aerodynamic work (rms enthalpy fluctuations less than 2% to 5%) with both alternating and direct current heaters. Author

N64-18131* Little (Arthur D.) Inc., Cambridge, Mass.

THERMAL MODELING OF A SIMULATED JPL SPACECRAFT, PHASE I RESULTS

Frank Gabron and Arthur A. Fowle Sep. 1962 73 p refs Work performed for JPL

(NASA Contract NAS7-100; JPL Contract 950252)

(NASA CR-53455; C-64924) OTS: $7.60 ph

Dimensionless groups of thermal-modeling parameters were derived to identify methods for testing reduced-scale thermal models, and for predicting from those experiments, the thermal characteristics of full-scale spacecraft vehicles or components. The following heat-transfer phenomena were considered in the analysis: (1) heat transport by solid conduction; (2) heat transport at solid-to-solid interfaces; (3) heat generated by internal power sources; (4) internal energy changes during transients; (5) heat transport via thermal radiation emitted from surfaces; and (6) heat transport via radiation absorbed at surfaces. It was concluded that precise thermal modeling is inherently limited by the size of the smallest scaled model (as measured by the input power per unit volume). P.V.E.

N64-18274 National Academy of Sciences—National Research Council, Washington, D.C.

REPORT ON THE CONFERENCE ON CRITICAL TABLES OF THERMODYNAMIC DATA

Guy Waddington et al [1963] 78 p refs Conf. held in Washington, 14–15 Mar. 1963

This report discusses: (1) the philosophy, history, and status of the critical-tables concept, particularly in relation to thermo-

dynamics; (2) the current activities of various groups in the country concerned with the tabulation program; (3) specific requirements for thermodynamic-data tabulation and their scope; and (4) the financial and technical resources necessary to carry on needed programs. I.v.L.

N64-18295 Joint Publications Research Service, Washington, D.C.
HIGH-TEMPERATURE THERMODYNAMICS AND THERMOPHYSICS
10 Apr. 1964 6 p Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1964 p 133–134
(JPRS-24143; OTS-64-31054) OTS: $0.50

This research status report on high-temperature thermodynamics and thermophysics includes: (1) the development of new methods of intensifying heat transfer; (2) the development of methods for high-temperature heat recovery in installations for the direct conversion of thermal energy into electrical energy; (3) the clarification of the radiative heat-transfer features of gas-jet combustion; (4) the conduction of research on heat transfer of sectional tubes with undulant surfaces that can increase the compactness of high-temperature heat-transfer apparatus; (5) the conduction of investigations of the mechanism of boiling liquids and solutions, heat-transfer, critical thermal streams, and hydraulic resistance in tubes and annular channels in a broad range of velocities, pressure, and other parameters, as well as heat transfer in fusions of polymer materials and also on the evaporative cooling of electric generators; (6) the development of a new method for studying combustion processes in isolated particles and the derivation of basic kinetic laws for the combustion of various fuels; and (7) research on a group of thermophysical properties of monomers and polymers and an elaboration on the theoretical bases for deriving high-strength synthetic fiber. I.v.L.

N64-18353 Little (Arthur D.), Inc., Cambridge, Mass.
METHODS FOR LOW POWER TEMPERATURE CONTROL
Second Quarterly Report, 1 Aug.-31 Oct. 1963
Igor A. Black and John F. Peterson [1963] 43 p
(Contract DA 36-039 AMC-02207(E))
(AD-434071)

This report describes work on an investigation of methods, techniques, and devices by which the temperature of a quartz crystal can be maintained, with a minimum of power, at a nominal operating temperature over environmental temperature extremes. The work includes investigations of second-order effects applicable to the design of low-power crystal ovens. End products resulting from the study are three types of ovens: (1) a 3-in.^{3}, 500-mw oven (Type J6) requiring accessibility to the crystal and operating at +75° C ±1° C over a −55° to +60° C ambient; (2) a 3-in.^{3}, reduced power, sealed oven (Type K6G) with similar operating requirements; and (3) a 4-in.^{3}, 250-mw oven (Type L6) requiring accessibility to a chamber capable of housing two crystals and operating at 0° C to ±1° C over a −55° to 0° C ambient. Several welding techniques for sealing the metal shell around the core were considered. Electron-beam welding was found particularly adaptable for producing the seal without overheating the core. Author

N64-18510 Argonne National Lab., Ill.
THE SLUG-ANNULAR FLOW REGIME TRANSITION AT ELEVATED PRESSURE
Peter Griffith Nov. 1963 25 p refs
(Contract W-31-109-ENG-38)
(ANL-6796) OTS: $0.50

The slug annular-flow regime has been investigated in vertical upflow without heating through the use of an electrical conductivity probe. The Teflon cladding and seals of the probe were found to work to at least 488° F. When the inlet velocity was sufficiently high, the quality at transition was found to be a constant for each pressure going from 8.6% at 215 psia to 17.6% at 615 psia. No fully developed bubbly flow was observed. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-17993* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A PILOTED SIMULATOR STUDY OF LONGITUDINAL HANDLING QUALITIES OF SUPERSONIC TRANSPORTS IN THE LANDING MANEUVER
Richard S. Bray Washington, D.C., NASA, Apr. 1964 33 p refs
(NASA TN D-2251) OTS: $0.75

A piloted simulator incorporating simulated visual cues in the landing maneuver was used in an exploratory study of several parameters pertinent to the stability and control characteristics of supersonic transports. The result of pilots' assessments of speed–thrust instability in the landing approach, which is associated with the lift–drag characteristics of a low-aspect-ratio delta wing, indicated that the condition would not be tolerable for normal operation of a transport aircraft, but would be acceptable for emergency operation. Low values of static longitudinal stability were accepted; however, neutral static stability was considered tolerable only in an emergency condition. Measurements of landing touchdown performance parameters from simulated landings indicated that no severe longitudinal control difficulties were apparent in the flare and touchdown maneuver over the limited flight conditions represented in the tests and for the range of variables considered. Author

N64-18490 Rocketdyne, Canoga Park, Calif.
SOURCES OF INFORMATION IN HUMAN FACTORS ENGINEERING, INCLUDING ASSOCIATED AREAS IN SYSTEM SAFETY, MAINTAINABILITY, PERSONNEL SUBSYSTEM, LIFE SCIENCES, QUALITY ASSURANCE, AND RELIABILITY ENGINEERING
George A. Peters and Frank S. Hall 15 Jan. 1964 83 p refs
(RH-3398B)

A comprehensive listing of regulatory and guidance documents pertaining to human-factors engineering and to areas of technical overlap or interdependence is presented. The references are divided into the following groups: (1) regulatory and guidance documents—a listing of documents that specifies what should be done by human-factors activities, including various regulations, specifications, standards, manuals, instructions, and programs requirements that attempt to define the character of the contractors human-factors functions; (2) descriptive publications—a sampling of government agency reports that attempt to describe how various functions might be accomplished, review the state-of-the-art in a given area, present new methods, or list basic data that might be useful

in human-factors analysis; (3) illustrative reports—a cross section of contractually required or data submittal reports, representative of what was actually accomplished, how it was done, and the type of organization or approach that was utilized; and (4) reference sources—a guide on where to go for technical information in the field of human-factors engineering. P.V.E.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-17849 Utah State U., Logan Electro-Dynamics Labs.
LOGARITHMIC MULTICHANNEL RADIOMETER Final Report
D. J. Baker and C. L. Wyatt 1 Aug. 1963 61 p refs
(Contract AF 19(604)-7423; Proj. Defender)
(AFCRL-63-896; AD-431121)

The Model WW-1 logarithmic channel radiometer is described in detail, and complete working circuit and machine assembly drawings of the instrument are given. The radiometer employs narrowband Schott interference filters for operation in the 0.2μ to 3μ region, with a 10^5 dynamic range and a minimum detectable irradiance of 10^{-8} w/cm^2 as used on aerospace vehicles. Author

N64-17886* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
SENSORY AIDS RESEARCH
S. J. Mason, D. E. Troxel, J. K. Dupress, W. L. Black, J. K. Clemens et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 279 (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

The long-range objective of the work is to contribute to the development of useful technological aids for blind and blind–deaf people. Most of the present work is concerned with studies of the acquisition and processing of visual information for presentation to the nonvisual senses. Projects include mobility-aid simulation, reading-machine problems, tactile and kinesthetic displays, multimodality sensory communication, and real-time computer-facility development. Author

N64-17988* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HIGH-TEMPERATURE, THIN-FILM RESISTANCE THERMOMETERS FOR HEAT TRANSFER MEASUREMENT
Leonard Bogdan Washington, NASA, Apr. 1964 30 p ref
(NASA Contract NAS8-823)
(NASA CR-26) OTS: $1.00

Development of a high-temperature, thin-film resistance thermometer for heat-transfer measurements is described. This heat-transfer gage, comprising a thin, platinum-alloy film deposited on a pyrex substrate, is operable at sustained steady-state temperatures to 1,000° F. Details of the calibration procedures employed to evaluate the thermal and electrical characteristics of the gage are described. The calibration data are presented and compared with other published data in the temperature range in which direct comparison is possible. Author

N64-17992* Johns Hopkins U., Baltimore, Md.
INSTRUMENTATION FOR FAR ULTRAVIOLET ROCKET SPECTROPHOTOMETRY
William G. Fastie Washington, D.C., NASA, Apr. 1964 25 p
(NASA Grant NsG-193-62)
(NASA TN D-2250) OTS: $0.75

Instrumentation and techniques are described that permit basic measurements to be made of interactions between photons, ions, atoms, and molecules for which no other means of observation are available. Author

N64-18061 Franklin Inst., Philadelphia, Pa.
CONDENSER TILTING DEVICE FOR DIFFRACTED BEAM MICROSCOPY IN THE RCA-EMU3 ELECTRON MICROSCOPE Scientific Report No. 3
Alfred Baltz Bedford, Mass., AFCRL, Dec. 1963 10 p Submitted for Publication
(Contract AF 19(628)-2415)
(AFCRL-64-43; AD-432902)

When using diffracted-beam electron microscopy to examine thin foils, it is sometimes desirable to tilt the illuminating system to bring the diffraction spot to the center of the screen. In the RCA-EMU$_3$ type microscope it is necessary to traverse the condenser assembly and tilt the electron beam to return the illumination to the center of the screen. A simple device is described that was built to replace the condenser alignment controls that are used when it is necessary to tilt the illuminating system an appreciable amount. The device can be removed, and the instrument can be returned to normal operation by simply disconnecting it from the condenser coils. P.V.E.

N64-18069 Army Map Service, Washington, D.C.
THE ASTROGRAPHIC ACCURACY OF A RECONNAISSANCE CAMERA
Frederick W. Fallon Aug. 1963 20 p
(Tech. Rept. 36; AD-434400)

The optical properties of the K-17 aerial reconnaissance camera were studied to determine the accuracy to which such a camera can be used to determine the position of a point of light on the celestial sphere, relative to the known, fixed positions of the stars. From a photograph of a section of sky, a conventional least-squares plate reduction was made from measurements of 50 to 100 stars. The residuals are analyzed with respect to the type of mounting used, the number of stars used in the solution, exposure parameters, position on the plate, and magnitude. Author

N64-18119* Beckman Instruments, Inc., Fullerton, Calif.
RUGGEDIZED INFRARED CARBON DIOXIDE ANALYZER Final Progress Report and Manual
Robert R. Pintar 15 Mar. 1963 38 p
(NASA Contract NAS2-711)
(NASA CR-53359) OTS: $3.60 ph

The theory of operation, installation instructions, operating instructions, and maintenance procedures for the ruggedized infrared carbon dioxide analyzer are presented. The detector is composed of a sample detector and a reference detector that are optically in tandem. Modulated infrared energy from the source is transmitted through a gas sample being measured in cell #1 (the sample detector). Cell #1 is charged with CO_2. The infrared energy in the CO_2 absorption band is virtually eliminated in the first cell. The remaining energy is transmitted into cell #2 (the reference detector). Cell #2 is charged with COS. In cell #2, the energy at the edge of the CO_2 absorption band is absorbed by the COS. The resulting detector is a CO_2 sensor with a sample detector highly selective to infrared energy changes

in the center of the CO_2 absorption band and a reference detector highly selective to energy changes on the CO_2 band edges. When CO_2 is present in the gas sample being measured, cell #1 experiences a greater loss in received energy than cell #2. This relative change of absorbed energy is ultimately detected and used to indicate the concentration of the CO_2 in the gas sample. P.V.E.

N64-18130 Radiation Inc., Melbourne, Fla.
STABILITY OF NULL VOLTAGE OF HALL GENERATORS FOR DIGITAL TRANSDUCER READOUT HEADS Supplemental Report
C. B. Pear, Jr. Dec. 1963 75 p refs
(Contract AF 33(657)-7681)
(AD-434401) OTS: $7.60

This report covers an attempt to find the extent to which drift of the null or zero field voltage limits the usefulness of Hall generators in flux responsive magnetic reading heads. A search of the literature is covered, and samples representing the best commercially available construction were tested. For the conditions imposed by a digital transducer application, it appears that heads with a resolution of 5,000 bits per inch can be operated without adjustments in a temperature range up to 100° C and with greater resolution over smaller temperature ranges. Erratic temperature changes limit the degree to which compensation can be effective. Author

N64-18153 Aeronautical Research Council (Gt. Brit.)
THE USE OF SURFACE PITOT TUBES AS SKIN-FRICTION METERS AT SUPERSONIC SPEEDS
K. G. Smith, L. Gaudet, and K. G. Winter London, HMSO, 1964 39 p refs
(ARC-R&M-3351; supersedes RAE-AERO-2665, ARC-24179) HMSO: 15 s

Experiments have been made, in supersonic turbulent boundary layers, on a simple type of surface pitot tube, formed by cementing a piece of razor blade over a static-pressure hole. This type of surface pitot tube has great practical advantages, as surface-shear measurements may be made on any model designed for pressure measurements. A calibration curve, which is sensibly independent of Mach number, has been obtained for the dependence of the pressure rise at the pitot tube on the surface shear, both terms being made nondimensional. Examples are included of the use of surface pitot tubes on two models. The models were a delta wing and a biconvex cone, and the tests covered a range of Mach numbers, Reynolds numbers, and model incidence. Author

N64-18176 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
NONLINEAR ANALOG NETWORK TO CONVERT SURFACE TEMPERATURE TO HEAT FLUX
L. S. Schmitz Jun. 1964 44 p refs
(CAL-130)

Two nonlinear analog networks, which carry out the mathematical operation of transforming a voltage proportional to instantaneous surface temperature into a voltage proportional to heat flux when the thermal conductivity and thermal capacity of the thin-film gage and pyrex substrate become functions of temperature, have been devised for use with thin-film resistance thermometers in hypersonic shock tunnel application. One circuit employs the characteristics of voltage-variable silicon capacitors, and the other employs the use of zener diodes. The circuit employing the silicon capacitors was designed, built, and tested. In addition, a voltage divider incorporating nonlinear resistors was designed to compensate for the nonlinearity of the resistance–temperature characteristic of the platinum thin film. Design techniques for these circuits are discussed, together with experimental results for the silicon capacitor analog circuit. A calibration technique compatible with current calibration procedures is also discussed. Author

N64-18189 Naval Radiological Defense Lab., San Francisco, Calif.
PROTOTYPE OF A PORTABLE MICROCALORIMETER FOR MEASUREMENT OF ABSORBED DOSE
E. R. Schleiger and N. Goldstein 6 Jan. 1964 18 p refs
(USNRDL-TR-710; AD-433633)

A prototype of a compact, portable microcalorimeter has been built that measures ionizing radiation dose rates as low as 3 aluminum rads/min. The absorber and temperature sensing system are similar to those of an earlier device, but the temperature-controlled bath described therein has been replaced by an aluminum isothermal shield bolted to the bottom surface of a copper reservoir containing liquid nitrogen. Both the shield and the reservoir are contained in a vacuum chamber. Calibration of the absorber is accomplished by observing the response of an imbedded thermistor when the calorimeter is placed in a gamma-ray field of known exposure level provided by a 200-curie Co^{60} source. Plans are presented for extending this method of temperature control to a smaller microcalorimeter (outside diameter 2.25 in.). Author

N64-18209 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
FAST-RESPONSE, PLATINUM-FILM TEMPERATURE PROBES [SONDES THERMOMETRIQUES A FILM DE PLATINE A RESPONSE RAPIDE]
Monique Scagnetti and Jean Crabol Repr. from Rech. Aeron. (Chatillon-sous-Bagneux), no. 97, Nov.–Dec. 1963 p 23–30 refs In FRENCH; ENGLISH summary
(*Its* T.P. No. 83(1963))

Platinum-film, silica temperature probes have been designed and built for shock-tube studies. The manufacturing processes and the means of calibration are indicated, as well as the method used to evaluate the heat transfer from the recorded temperature curves. Results are interpreted to permit the transposition of the experimental data to the case of walls made of any material. Author

N64-18210 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
QUANTITATIVE STRIOSCOPY USING A COLOURED GRID AND A MULTIPLE ENTRANCE SLIT [STRIOSCOPIE QUANTITATIVE A GRILLE COLOREE ET FENTE D'ENTREE MULTIPLE]
Jean Surget Repr. from Rech. Aeron. (Chatillon-sous-Bagneux), no. 97, Nov.–Dec. 1963 p 37–42 refs In FRENCH; ENGLISH summary
(*Its* T.P. No. 85(1963))

A colored strioscopy method is presented. The apparatus, using colored grids, presents in its multientrance slit version the same advantage of high luminosity as found in the interferential strioscopy apparatus. The disadvantage of having to use glass windows completely free of tension is avoided because the system is completely insensitive to birefringence effects. The principle of the method is discussed, and the apparatus built for the S-3 supersonic wind tunnel of the ONERA Center of Modane is described. Some notions concerning the processing of the data obtained are also given. Author

N64-18211 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
PRECISION MEASUREMENT OF TIME INTERVALS [MESURES PRECISES D'INTERVALLES DE TEMPS]
Michel Pagny and Pierre Weber Repr. from Rech. Aeron. (Chatillon-sous-Bagneux), no. 97, Nov.–Dec. 1963 p 43–53 refs In FRENCH; ENGLISH summary
(*Its* T.P. No. 86(1963))

The clock trajectography system is based on the accurate measurement of time intervals necessary for radiowaves issued by a vehicle to reach the ground. The frequency quality criteria are defined, the means used for measuring these qualities are presented, and the studied frequency standards are described. The working conditions of the electronic timers are exposed, and their characteristics are defined. Analysis of the conditions for using a timer in the precise case of clock trajectography elucidates the main difficulties and presents some solutions. Author

N64-18212 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
SHORT RESPONSE-TIME PIEZO-ELECTRIC BALANCE [BALANCE PIEZO-ELECTRIQUE A COURT TEMPS DE REPONSE]
Roland Hoarau Repr. from Rech. Aeron. (Chatillon-sous-Bagneux), no. 98, Jan.–Feb. 1964 p 43–48 refs In FRENCH; ENGLISH summary
(*Its* T.P. No. 98(1964))

Designing fast-response instrumentation for measurement of pressure, heat transfer, forces, and moments has been necessary in the case of intermittent wind tunnels with short running times, particularly in Hot Shot tunnels in which the measurement time is less than 40 milliseconds. The reasons why quartz balances have been designed are given. Such instrumentation, used in Hot Shot Tunnel for measurement of drag, lift, and pitching moment, is described. Author

N64-18261 Vanderbilt U., Nashville, Tenn.
EXPERIMENTAL INVESTIGATION OF A PROTOTYPE NOISE EXPOSURE METER
Robert W. Benson Wright-Patterson AFB, Ohio, Biophys. Lab., Feb. 1964 24 p
(Contract AF 33(616)-8436)
(AMRL-TDR-64-4; AD-434404) OTS: $1.00

The meter, utilizing electrochemical storage cells, provides a measure of total integrated noise energy to which its wearer is exposed during a day. The instrument performs within reasonable tolerances of those characteristics specified in the original design. Additional circuitry was installed to provide an indication of overload of the instrument. Author

N64-18359 Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF IMPROVED STATIC PRESSURE SENSING PROBES FOR ALL MACH NUMBERS, PHASE III Final Report, 1 Jan.–31 Dec. 1963
6 Feb. 1964 56 p
(Contract NOw-62-0297-t)
(LB-31575; AD-435113)

The purpose of the entire effort is to develop systematic, analytic methods for the design of static pressure probes, which will correctly sense free-stream static pressure independently of Mach number, Reynolds number, and flow inclination. This report describes the design of two service-type static pressure probes designed by this method and analyzes the results of wind-tunnel tests of these probes. Both service-type probes had total pressure sensors in their noses and contained internal heating elements. The external shape of both service-type probes is identical, and they differ only in the internal ducting used to obtain insensitivity of the static pressure to angle-of-attack and yaw. During the tests both probes appeared to sense static pressure fairly well at zero angle-of-attack and yaw, and one of them also did fairly well at nonzero angle-of-attack and yaw. Author

N64-18511 Bureau of Mines, Rolla, Mo.
A SERVOMECHANICAL SYSTEM FOR MEASURING VAPOR PRESSURE OF METAL HALIDES
L. C. George and J. W. Jensen 1964 20 p refs
(BM-RI-6421)

A new system for precisely counterbalancing and measuring vapor pressure operates by servomechanical principles. It was developed with the objective of determining the vapor-pressure equations of metal halides. The system is isolated from the vapor-pressure bulb by a diaphragm transducer that signals a pressure regulator to null any pressure difference that is detected. Pressure measurement and readout are continuously performed by a servomanometer, accurate to ±0.003 cm Hg for the range of 0.1 to 200 cm Hg. High response rate and sensitivity are obtained. Methods of use are described, and results for $CdCl_2$ and $PbCl_2$, in agreement with data of other investigators, are given as examples. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-17864 Boyce Thompson Inst. for Plant Research, Inc., Yonkers, N.Y.
RESEARCH ON TISSUE CULTURES OF HIGHER PLANTS
Walter Tulecke Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs. (6570th), Dec. 1963 34 p refs
(Contract AF 33(657)-9298)
(AMRL-TDR-63-124; AD-431213)

The nutrient requirements of several plant tissue cultures, their protein content, and their ability to fix carbon dioxide were investigated. These studies were undertaken to compare higher plant tissue cultures with the alga, *Chlorella pyrenoidosa* (Indiana #26). Several plant tissue cultures could be grown on defined media, but these media were more complex than those required for *Chlorella*. The protein in the alcohol insoluble residue of *Chlorella* was 60%, and the protein in the same residue from tissue cultures was 10% to 39%. The carbon dioxide fixation of *Chlorella* exceeded the fixing capacity of the tissue cultures, but some appreciable photosynthetic activity was recorded for tomato tissue. These results are considered preliminary and are not considered indicative of the best autotrophic higher plant tissue cultures that could be obtained. Author

N64-17882* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
SPEECH COMMUNICATION
K. N. Stevens, M. Halle, J. B. Dennis, J. M. Heinz, A. S. House et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 211 (See N64-17876 10-01) (NASA Grant NsG-496; Contract AF 19(628)-3325; NSF Grant G-16526; NIH Grant MH-04737-03; NIH Grant NB-04332-01)

Research activities include the development of procedures for the analysis and synthesis of speech, and the use of these procedures in the study of human-speech processes. R.T.K.

N64-17884* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

COMMUNICATIONS BIOPHYSICS

M. Eden, J. L. Hall, II, W. T. Peake, R. R. Pfeiffer, W. A. Rosenblith et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 223–231 refs (See N64-17876 10-01)

(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

The major research efforts have been directed toward an understanding of the communication senses, particularly the sense of hearing. Activity is concentrated in the four major areas of neuroelectric studies, psychophysical and behavioral studies, investigations of mathematical models, and research on problems in instrumentation and data processing. R.T.K.

N64-17885* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

NEUROPHYSIOLOGY

W. S. Mc Culloch, F. S. Axelrod, H. A. Baldwin, P. O. Bishop, M. Blum et al *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 233–256 refs (See N64-17876 10-01)

(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03; NIH Grant NB-04897-01; Contract AF 33(616)-7783)

Among the topics discussed are: (1) algorithmic theories of growth and differentiation; (2) measures on the computation speed of partial recursive functions; (3) olfaction; (4) nonlinear operator in the pupil system; (5) double oscillations in the pupil servomechanism; (6) accommodation tracking; (7) experiments on error as a function of response time in horizonal eye movements; (8) optokinetic nystagmus in man; and (9) remote on-line computer diagnosis of the clinical electrocardiogram. R.T.K.

N64-17921 Wisconsin U., Madison Mathematics Research Center

LITERATURE REVIEW OF EXPERIMENTAL DESIGN THROUGH 1949

W. T. Federer Feb. 1964 161 p 1451 refs

(Contract DA-11-022-ORD-2059)

(MRC-TSR-405; AD-433913)

This review of literature in the conduct, the design, and analysis of data from experiments contains a bibliography of slightly less than 1,500 references through the year 1949. Reference is made to the several previous bibliographies in this area; since the applications and needs have been traditionally in the various fields of biology, the references are preponderantly from journals that pertain to biology. Author

N64-17924 School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

THE EFFECTS OF ALCOHOL AND HYPOXIA ON THE HETEROPHORIAS

Richard L. Masters Feb. 1964 24 p refs

(*Its* Aeromed. Rev. 2-64; AD-433129)

The available literature on the effects of alcohol (ethanol), and the effects of hypoxia on the phorias is reviewed. Author

N64-17926 State U. of New York at Buffalo School of Medicine

STUDIES IN PULMONARY PHYSIOLOGY: MECHANICS, CHEMISTRY, AND CIRCULATION OF THE LUNG, VOLUME I (1959-1963)

Hermann Rahn and Leon E. Farhi Wright-Patterson AFB, Ohio, Aerospace Med. Res. Labs. (6570th), Oct. 1963 285 p refs (Contract AF 33(616)-6823; Contract AF 33(657)-10082) (AMRL-TDR-63-103(1); AD-426967) OTS: $4.00

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N64-17927 State U. of New York at Buffalo School of Medicine

ABDOMINAL AND THORACIC PRESSURES AT DIFFERENT LUNG VOLUMES

Emilio Agostoni and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 1–6 refs (See N64-17926 10-16) OTS: $4.00

The abdominal (gastric) pressures as well as the intrathoracic pressures were recorded in man during various respiratory maneuvers, such as complete relaxation, moderate inspiratory and expiratory efforts, maximal inspiratory and expiratory efforts, and during maximal abdominal pressure efforts. Each maneuver was systematically carried out at various lung volumes. From these measurements it is possible to determine the transdiaphragmatic pressure difference and thus obtain information concerning the activity of the diaphragm during these various maneuvers. During relaxation pressure maneuvers and during moderate expiratory pressure efforts the transdiaphragmatic pressure difference is zero. During maximal inspiratory efforts the pressure is about 100 cm H_2O more positive on the abdominal side than on the thoracic side of the diaphragm regardless of the lung volume. Author

N64-17928 State U. of New York at Buffalo School of Medicine

VELOCITY OF MUSCLE SHORTENING AS A LIMITING FACTOR IN RESPIRATORY AIR FLOW

Emilio Agostoni and W. O. Fenn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 7–11 refs (See N64-17926 10-16) OTS: $4.00

The pressure volume relationship of the respiratory apparatus during maximum inspiration and expiration, made as quickly as possible through different resistances, has been determined. The time course of the alveolar pressure during such events has been described. The maximum work done by the respiratory muscles increases as the resistance increases and as the speed of muscle shortening decreases. The relationship between maximum work and mean velocity or, at a given volume, between alveolar pressure and instantaneous flow is nearly linear. The discrepancy between the relationship found and the hyperbolic one described by the characteristic equation of the muscles is ascribed to the geometrical and anatomical complexities of the respiratory apparatus. The results, however, show that the airflow is limited by the rate with which the muscles are able to mobilize chemical potential energy for the performance of work. Author

N64-17929 State U. of New York at Buffalo School of Medicine

ABDOMINAL MUSCLE AND DIAPHRAGM ACTIVITIES AND CAVITY PRESSURES IN PRESSURE BREATHING

Beverly Bishop *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 12–17 refs (See N64-17926 10-16) OTS: $4.00

The respiratory contribution of the diaphragm and external oblique abdominal muscle has been assessed by recording from the anesthetized cat the integrated electromyograms during continuous pressure breathing. As the intrapulmonary pressure is progressively reduced from 0 to -12 cm H_2O, the diaphragm becomes increasingly active until it has no silent period during the respiratory cycle. Concomitantly, any respiratory activity in the abdominal muscle is completely silenced. When the animal is subjected to pressures from 0 to $+14$ cm H_2O, the diaphragm is initially inhibited and the abdominal muscle becomes increasingly active. During negative pressure breathing, respiration is an inspiratory act, and only the thorax is subjected to stress. During positive pressure breathing, respiration is an expiratory act, and both the thorax and abdomen are subjected to the stress. Author

N64-17930 State U. of New York at Buffalo School of Medicine

REFLEX CONTROL OF THE ABDOMINAL MUSCLES DURING POSITIVE PRESSURE BREATHING

Beverly Bishop *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 18–33 refs (See N64-17926 10-16) OTS: $4.00

An investigation was undertaken to determine the location of receptors responsible for the active expiration of continuous

positive pressure breathing and the pathways subserving this reflex. Anesthetized cats were used in the study. The cats were subjected to continuous positive pressure breathing and the diaphragm was inhibited; the abdominal muscles became active during expiration. The higher the pressure to which the animals were subjected, the more severe was the diaphragm inhibition and the greater the abdominal muscle participation. The experiments conducted in this study have demonstrated that one essential component for initiating and maintaining active expiration during continuous positive pressure breathing lies in the thorax. It was found that abdominal vagotomy or complete abdominal evisceration does not interrupt the abdominal muscle response to continuous positive pressure breathing, which can be abolished by bilateral cervical vagotomy. C.L.W.

N64-17931 State U. of New York at Buffalo School of Medicine

EFFECT OF NEGATIVE PRESSURE BREATHING ON LUNG MECHANICS AND VENOUS ADMIXTURE

Tulio Velasquez and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 34–50 refs (See N64-17926 10-16) OTS: $4.00

In a study of negative pressure breathing in anesthetized dogs, means were taken to quantitate the changes in reference to the pressure applied, to determine the factors involved, and to study the relationship between changes in respiratory compliance and those occurring in the venous admixture. In studying the changes in total respiratory compliance, a muscle relaxant was used in order to measure only the elastic forces. The studies on the venous admixture were conducted on animals ventilated with 100% O_2 to exclude effects of distribution and diffusion limitations. C.L.W.

N64-17932 State U. of New York at Buffalo School of Medicine

DETERMINATION OF ALVEOLAR CAPILLARY TEMPERATURE

A. W. T. Edwards, T. Velasquez, and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 51–57 refs (See N64-17926 10-16) OTS: $4.00

Knowledge of the solubility of most inert gases in arterial blood may be used to determine the equilibration temperature, i.e., alveolar temperature. Because the partial pressure of inert gas in arterial blood cannot be deduced from the alveolar pressure, direct determination of solubility is impractical. If a mixture of two inert gases is used, the ratio of partial pressures in the arterial blood is equal to that in the inspired gas, and the ratio of gas contents will vary with the ratio of solubility. The blood solubility ratio He/A varies by 1.34% per degree centigrade. Using an O_2-He-A inspired mixture, the following points were established in five resting subjects, fully clothed: (1) The pulmonary capillary temperature (T_{PC}) is linearly related to the rectal temperature (T_R), with a regression line equation: $T_{PC} = 37.5 + 2.4\ (T_R - 37.1)$. (2) When measurements were obtained on the same subject on different days, these measurements show that variations in T_{PC} are in the same direction as changes in T_R, but much more pronounced. Author

N64-17933 State U. of New York at Buffalo School of Medicine

ESTIMATION OF TRUE VENOUS AND ARTERIAL P_{CO_2} AND CARDIAC OUTPUT BY GAS ANALYSIS OF A SINGLE BREATH

T. S. Kim, Hermann Rahn, and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 58–73 refs (See N64-17926 10-16) OTS: $4.00

The method presented is one of the several bloodless cardiac output techniques. It entails no discomfort to the patient and requires no blood analysis. When compared to other rebreathing or reequilibration methods its advantages become apparent: no timing is required, no complex breathing maneuvers have to be performed, no special gas mixtures are needed, and the apparatus required is standard. C.L.W.

N64-17934 State U. of New York at Buffalo School of Medicine

ALVEOLAR GAS EXCHANGE DURING BREATH HOLDING WITH AIR

E. H. Lanphier and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 74–78 refs (See N64-17926 10-16) OTS: $4.00

Four normal subjects used a partial rebreathing procedure to deliver frequent alveolar gas samples during breath holding with air. In breath holding during mild exertion, O_2 uptake declined steadily, while CO_2 transfer dropped abruptly and later ceased entirely as alveolar P_{CO_2} reached a virtual plateau. Application of estimated instantaneous values of the mean exchange ratio (R) provided an indication of mixed venous blood values and permitted interpretation in terms of the changing venous–alveolar–arterial relationships. Arterial P_{CO_2} very early equaled mixed venous P_{CO_2}, and then increasingly exceeded it. The plateau of alveolar P_{CO_2} was due in part to the fall in alveolar P_{O_2} since decreasing O_2 uptake lessened the CO_2-concentrating effect of lung-volume reduction, while the P_{CO_2}-elevating effect of blood oxygenation was also diminishing. However, an important slowing of the rise in mixed venous CO_2 content and P_{CO_2} was also noted and remains unexplained. Author

N64-17935 State U. of New York at Buffalo School of Medicine

ALVEOLAR GAS EXCHANGE DURING BREATH-HOLD DIVING

E. H. Lanphier and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 79–85 refs (See N64-17926 10-16) OTS: $4.00

Use of a recompression chamber permitted simulation of breath-hold dives to 33 ft of sea water (2 atm abs). Four normal subjects made such dives during rest and mild exertion while delivering alveolar gas samples at frequent intervals by a partial-rebreathing procedure. The course of alveolar gas exchange differed greatly from that in ordinary breath holding. Oxygen uptake remained at near normal levels until ascent owing to the maintenance of alveolar P_{O_2} by increased ambient pressure. Reversal of CO_2 transfer occurred during descent, and little CO_2 moved in the normal direction until ascent. Greater uptake of oxygen and retention of CO_2 in the body led to lower final values of both alveolar P_{O_2} and P_{CO_2} than in comparable breath holding at the surface. Hyperventilation made possible longer dives with harder work, and in these the P_{O_2} reached very low values on ascent. One subject showed a final P_{O_2} of 24 mm Hg with evidence of reversed O_2 transfer. Acute hypoxia on ascent is a likely cause of drowning in breath-hold diving. Author

N64-17936 State U. of New York at Buffalo School of Medicine

LESSONS FROM BREATH HOLDING

Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 86–93 refs (See N64-17926 10-16) OTS: $4.00

This report deals with oxygen and carbon dioxide tension through breath holding and the changes in respiratory drives with altitude acclimatization. Observations were made of subjects during the process of breath holding and of subjects at differing sea levels. Observations were also made of subjects holding their breath under water. C.L.W.

N64-17937 State U. of New York at Buffalo School of Medicine

DETERMINATION OF DISSOLVED N_2 IN BLOOD BY GAS CHROMATOGRAPHY AND (a-A)N_2 DIFFERENCE

Leon E. Farhi, A. W. T. Edwards, and T. Homma *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 94–103 refs (See N64-17926 10-16) OTS: $4.00

By combining vacuum extraction in a Van Slyke chamber and separation of the extracted gases in a gas chromatograph, it is possible to determine N_2 content of 1.5 ml of blood or other biological fluids in less than 10 min. The 95% confidence limits are 0.44% on either side of the mean of the triplicate analysis, or 2.4 mm P_{N_2} in arterial blood when breathing room air. Application of the method to the problem of arterial–alveolar N_2 difference yielded the following data: (1) N_2 solubility in whole blood at 37.3° C varied from 0.0125 to 0.0129. (2) N_2 solubility in urine is inversely related to urine specific gravity, confirming Klocke and Rahn's data. (3) Changes in arterial N_2 content were reflected in arm superficial venous blood and urine N_2 only after a considerable period of time, indicating that either of these will give an excellent indication of the mean P_{N_2} over a period of time. (4) There is no systematic difference between venous blood and urine P_{N_2}. (5) The (a-A)N_2 difference in nine normal subjects varied from 3.7 to 13.1 mm Hg. Author

N64-17938 State U. of New York at Buffalo School of Medicine

SIMPLE METHOD FOR RAPID DETERMINATION OF AN O_2 DISSOCIATION CURVE OF THE BLOOD

Pierre E. Haab, Johannes Piiper, and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 104–105 refs (See N64-17926 10-16) OTS: $4.00

A procedure has been devised for determining an O_2 dissociation curve using polarographic measurements of the blood O_2 tension. Instead of equilibrating blood samples with known O_2 tensions and measuring the resulting O_2 contents as in the classical approach, the present method relies on calculating the oxygen content in various blood mixtures and the direct measurement of the oxygen tensions. C.L.W.

N64-17939 State U. of New York at Buffalo School of Medicine

VENTILATION-PERFUSION RELATIONSHIP

Hermann Rahn and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 106–115 refs (See N64-17926 10-16) OTS: $4.00

The lung is an organ with millions of units, each having a finite ventilation–perfusion ratio. At a ratio of about 1, the oxygen and carbon dioxide tensions are "normal" and the "total flow requirements" at their lowest. At higher or lower ratios, the flow requirements increase rapidly, and the gas tension becomes abnormal. It is important to assess how many alveoli have normal $\dot{V}_A/\dot{Q}$ ratios. It can be shown that whenever two or more units of the lung do not have the same $\dot{V}_A/\dot{Q}$ ratio a pressure difference must be established for carbon dioxide, nitrogen, and oxygen between mixed pulmonary capillary blood and expired alveolar gas. The effect of uneven distribution can be measured by using the "triple gradient" analysis in which differences between alveolar gas and arterial blood for oxygen, carbon dioxide, and nitrogen serve as the basis for the calculations. Study of the carbon dioxide difference allows the determination of alveolar air shunt, and the oxygen gradient is used for calculating the blood shunt. The nitrogen study differentiates between shunt due to blood flow through nonexchanging tissue and that due to presence of hyperperfused areas. Author

N64-17940 State U. of New York at Buffalo School of Medicine

SIMULTANEOUS MEASUREMENT OF O_2, CO_2 AND N_2 ALVEOLO-ARTERIAL GAS PRESSURE DIFFERENCES

Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 116–119 refs (See N64-17926 10-16) OTS: $4.00

Of the three possible gradients the aAD_{N_2} measures specifically the existence of overperfused alveoli. The aAD_{CO_2} can theoretically result from several causes, but in fact it is an index of the existence of overventilated alveoli. The AaD_{O_2} is not specific and can result from uneven distribution, diffusion impairment, or venous admixture. Simultaneous measurement of all the three gradients is required to obtain an adequate idea of the parameters affecting alveolar–arterial relationships. Author

N64-17941 State U. of New York at Buffalo School of Medicine

REGIONAL DIFFERENCES IN GAS EXCHANGE IN THE LUNG OF ERECT MAN

John B. West *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 120–125 refs (See N64-17926 10-16) OTS: $4.00

Measurements of regional ventilation and blood flow using radioactive CO_2 show that both increase from apex to base of the lung; the results are used to build an integrated picture of gas exchange. Ventilation–perfusion ratios at nine levels of the lung have been calculated and differences in local gas exchange deduced. In the resulting model, alveolar O_2 tension changes by more than 40 mm Hg from apex to base, while CO_2 and N_2 tensions change by about 14 and 29 mm Hg, respectively. Maximal differences in O_2 saturation of end-capillary blood are 4%, but differences in CO_2 contents of 7 vol % and pH variations of 0.12 units occur. The O_2 uptake per unit lung volume increases eightfold down the lung while corresponding variations in CO_2 output are less than threefold. N_2 passes out of the blood in upper parts of the lung but into the blood in basal regions (net exchange is zero). Author

N64-17942 State U. of New York at Buffalo School of Medicine

TOPOGRAPHICAL DISTRIBUTION OF PERFUSION AND VENTILATION

John B. West *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 126–129 refs (See N64-17926 10-16) OTS: $4.00 (Sponsored in part by Med. Res. Council)

A discussion is given of the topographical distribution of perfusion and ventilation in the lung. The discussion covers

the use of radioactive gases as a tool in measuring regional blood flow and ventilation, as well as the factor affecting the clearance rate. C.L.W.

N64-17943 State U. of New York at Buffalo School of Medicine

ACTUAL AND IDEAL O_2 AND CO_2 TENSIONS IN PULMONARY VEIN OF DOG

John B. West and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 130–139 refs (See N64-17926 10-16) OTS: $4.00

A description is given of the results of sampling pulmonary venous blood in the anesthetized dog, by direct catheterization through the left side of the heart, and comparing the gas composition of these samples with that of arterial blood and the calculated ideal values. Observations made are in disagreement with the assumption that the gas tensions of a given group of alveoli are in equilibrium with those of the capillary blood and, consequently, those of the pulmonary-vein blood draining from that area. C.L.W.

N64-17944 State U. of New York at Buffalo School of Medicine

SIMPLE METHOD FOR DETERMINATION OF PERFUSION AND VENTILATION-PERFUSION RATIO OF THE UNDERVENTILATED ELEMENTS (THE SLOW COMPARTMENT) OF THE LUNG

Robert A. Klocke and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 140–148 refs (See N64-17926 10-16) OTS: $4.00

The rate of disappearance of inert gas during washout was monitored simultaneously in the alveolar gas and in the arterial blood. This allows calculation of the relative perfusion of the hypoventilated (slow) compartment and comparison of its ventilation–perfusion ratio to that of the total respiratory system. In five normal subjects, the slow compartment received 1.8% of the total ventilation and 2.3% of the lung perfusion, and had a $\dot{V}_A/\dot{Q}$ ratio of 81% of the total. By comparison, study of an emphysematous subject showed that 10% of the alveolar ventilation went to the slow compartment, which was perfused by 33% of the pulmonary flow. The procedure requires only one analytical method and is therefore applicable on a large scale. Author

N64-17945 State U. of New York at Buffalo School of Medicine

PERFUSION OF THE UNDERVENTILATED COMPARTMENT OF THE LUNGS IN ASTHMATIC CHILDREN

Marion K. Ledbetter, Erika Bruck, and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 149–157 refs (See N64-17926 10-16) OTS: $4.00

The distribution of the pulmonary circulation was studied in four normal children and in nine children suffering from asthma. The perfusion of the underventilated compartment of the lungs was less than 2% of the total in normals and as high as 12% in the others. This is more than the fraction of the ventilation to this compartment, which has, therefore, a relatively low $\dot{V}_A/\dot{Q}$ ratio. In addition, in patients with more severe forms of the disease, there were findings that could be ascribed to the presence of a perfused, but virtually unventilated, compartment. Even patients who had been free of symptoms for as long as 9 months did not show a readjustment in perfusion of the slow compartment that would restore its ventilation–perfusion ratio to normal values. Author

N64-17946 State U. of New York at Buffalo School of Medicine

UNEQUAL DISTRIBUTION OF PULMONARY DIFFUSING CAPACITY IN THE ANESTHETIZED DOG

Johannes Piiper, Pierre Haab, and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 158–165 refs (See N64-17926 10-16) OTS: $4.00

In anesthetized dogs, the alveolar–arterial O_2 pressure difference (AaD) was measured at alveolar O_2 pressures of 45, 75, 106, 146, and 255 mm Hg. The AaD values observed could not be explained by the conventional "shunt factor," "diffusion-limitation factor," or "distribution factor." However, the experimental data could be explained on the basis of the concept of unequal distribution of pulmonary diffusing capacity, D, to perfusion,Q. A procedure for estimation of the pattern of distribution of D to Q from experimental data is described. The results were compatible with the assumption that the lung consisted of a minimum of three functional compartments characterized by different D/Q ratios Author

N64-17947 State U. of New York at Buffalo School of Medicine

ABSORPTION OF VARIOUS INERT GASES FROM SUBCUTANEOUS GAS POCKETS IN RATS

Johannes Piiper, R. E. Canfield, and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 166–172 refs (See N64-17926 10-16) OTS: $4.00

A study was made of absorption of the inert gases, helium, argon, hydrogen, nitrogen, sulfur hexafluoride, nitrous oxide, and cyclopropane, from subcutaneous gas pockets in rats breathing oxygen. For interpretation of the data, a method of analysis was devised that permitted distinction between perfusion and diffusion as factors limiting the absorption rate. Application of this method to the experimental data leads to the conclusion that both perfusion and diffusion limitation were effective in determining the absorption rates of the inert gases, diffusion limitation being the more important factor. The blood flow responsible for the uptake of inert gas from the gas pocket, and the thickness of the tissue layer between blood and pocket gas could be crudely estimated. Author

N64-17948 State U. of New York at Buffalo School of Medicine

GAS COMPOSITION OF PRESSURIZED, PERFUSED GAS POCKETS AND THE FISH SWIM BLADDER

Johannes Piiper, H. T. Humphrey, and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 173–180 refs (See N64-17926 10-16) OTS: $4.00

The behavior of the composition of pressurized, perfused gas pockets is analyzed in theory and experimentally, with the aim of contributing to the understanding of the effect of differential absorption on the composition of the fish swim bladder gas. The equations describing the change in the composition of pressurized, perfused gas pockets are derived and experimentally verified. If a gas pocket initially containing room air is subjected to elevated pressure and perfused with water equilibrated with room air, the concentration of the less soluble gas, nitrogen, increases during the absorption process. High partial pressures of nitrogen and argon found in swim bladders of fish living at great depths can be qualitatively explained on the basis of accumulation of these gases by preferential absorption of oxygen and carbon dioxide, in connection with certain assumptions on the mode of secretion of the gases. Author

N64-17949 State U. of New York at Buffalo School of Medicine

GAS TRANSFER ACROSS THE SKIN IN MAN

Robert A. Klocke, G. H. Gurtner, and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 181–186 refs (See N64-17926 10-16) OTS: $4.00

The rates of helium, argon, and nitrogen transport were determined in the forearm and hand of a normal subject at ambient temperatures ranging from 18° to 43° C, analysis being performed by gas chromatography. At any temperature, the ratio V_A/V_{He} was found to be equal to $(\alpha A \cdot PA/\sqrt{\text{mol wt A}})/(\alpha He \cdot P_{He}/\sqrt{\text{mol wt He}})$, where V is the rate of gas transport, α the solubility of the gas in blood, P the pressure of the gas in the blood, and mol wt the molecular weight of the gas. This indicates that the gas transport is limited by diffusion through the skin barrier and is affected only indirectly by changes in cutaneous blood flow in individual capillaries. Gas transport is at a minimal value at temperatures below 28° C, increasing in a linear fashion with increasing temperature above 28° C. This increase in transport shows that the increase in cutaneous perfusion at elevated ambient temperatures is accompanied by the opening of additional capillaries, the resulting increase in diffusing capacity being responsible for the increase in gas transport. Author

N64-17950 State U. of New York at Buffalo School of Medicine

DYNAMICS OF CHANGES IN CARBON DIOXIDE STORES

Leon E. Farhi and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 187–197 refs (See N64-17926 10-16) OTS: $4.00

The wide scatter in reported CO_2 storage capacity of the body must reside in a factor or factors that have not sufficiently been taken into account. In order to determine what these factors may be, data for the CO_2 storage capacity of various organs and their perfusion were collected. Using these data, an electronic analog was constructed. By simulating various procedures and varying the parameters, several experimental conditions were reproduced. Since most of the CO_2 storage capacity resides in the muscle, perfusion of the muscle mass will determine the rate at which this storage capacity may be brought into play. At rest, reequilibration is always a lengthy process, requiring several hours. Author

N64-17951 State U. of New York at Buffalo School of Medicine

OXYGEN STORES OF MAN

Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 198–207 refs (See N64-17926 10-16) OTS: $4.00

Under conditions of prolonged apnea, the body calls upon the oxygen stores of the blood and the lung. The relative contribution of these two sources depends upon the absolute size of the lung O_2 stores. The latter can be greatly altered by (1) size of lung volume, (2) fraction of O_2, and (3) barometric pressure. Various examples are discussed. It would appear that the length of a maximal voluntary apnea is to a large extent controlled by the size of O_2 stores. Author

N64-17952 State U. of New York at Buffalo School of Medicine

THE ROLE OF N_2 GAS IN VARIOUS BIOLOGICAL PROCESSES WITH PARTICULAR REFERENCE TO THE LUNG

Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 208–227 refs (See N64-17926 10-16) OTS: $4.00

The role that N_2 molecules play in the human body is explored. The discussion covers the origin of the earth's atmosphere, N_2 gas pockets in the body, and life without inert gases. A review is given of the N_2 cycles in the body. The lung as a nitrogen concentrator or dilutor, the skin–lung cycle, and the N_2 cycle are included in the discussion. The arterial-alveolar gradient was studied, and a method is given for the determination of arterial N_2 pressure. C.L.W.

N64-17953 State U. of New York at Buffalo School of Medicine

SURVIVAL OF MICE IN ABSENCE OF INERT GAS

L. Mac Hattie and Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 229–232 refs (See N64-17926 10-16) OTS: $4.00

Mice were maintained for 51 days in an atmosphere of oxygen at total pressure of 197 mm Hg. This provides a normal inspired O_2 tension. CO_2 and N_2 pressures in the ambient atmosphere did not exceed 5 mm Hg. Under these conditions, animals usually did not encounter any difficulties. Several litters were born, and in one case young were conceived, born, and raised in virtual absence of inert gas. However, in several cases animals died within 48 hours after being subjected to this environment. Once past this period, only mechanical failure of the apparatus terminated these experiments. It is suggested that pulmonary atelectasis was responsible for these early deaths. Author

N64-17954 State U. of New York at Buffalo School of Medicine

THE EFFECT OF BAROMETRIC PRESSURE ON LUNG COLLAPSE FOLLOWING TRACHEAL OCCLUSION IN RATS BREATHING PURE OXYGEN

William G. Robertson and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 233–242 refs (See N64-17926 10-16) OTS: $4.00

Gas resorption from rats' lungs after O_2 breathing, followed by tracheal obstruction, has been studied quantitatively. The theoretical equations governing the collapse of the lungs have been derived, and there is good agreement between predicted and determined values. In addition to the O_2 uptake, the rate of lung collapse is also affected to some degree by the alveolar P_{CO_2} at the time of occlusion and to a very large extent by the ambient pressure. The time required for complete lung collapse varies linearly with ambient pressure—a theoretical T = 0 value corresponding to a pressure of 90 mm Hg—under which conditions, the normal water vapor and CO_2 would account for all the pressure in the alveoli. Author

N64-17955 State U. of New York at Buffalo School of Medicine

GASEOUS ENVIRONMENT AND ATELECTASIS

Hermann Rahn and Leon E. Farhi *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 243–257 refs (See N64-17926 10-16) OTS: $4.00

This report discusses man's environment and the resulting effects when this environment is inadequate or is not available. The discussion covers the effects of pressure per second, the effect of the absence of N_2 on metabolic functions, the effect

of the absence of N_2 on pulmonary function, the types of atelectasis, the rates of absorption atelectasis, and the procedures for testing atelectasis. C.L.W.

N64-17956 State U. of New York at Buffalo. School of Medicine

AQUATIC GAS EXCHANGE: THEORY

Hermann Rahn *In its* Studies in Pulmonary Physiol.: Mech., Chem., and Circulation of the Lung, Vol. 1 (1959–1963) Oct. 1963 p 258–273 refs (See N64-17926 10-16) OTS: $4.00

Equations are presented that describe the gas exchange of aquatic organisms in terms of the simultaneous O_2 and CO_2 pressures, exchange ratio, metabolic rate, and gill ventilation. These equations may be compared directly with those of air breathers and emphasize the differences in the limit that each medium imposes upon the gas exchange. To maintain comparable O_2 tensions in a gill and an alveolus, the gill ventilation must exceed the alveolar ventilation 25 to 30 fold depending upon the temperature. This relatively high gill ventilation reduces the gill–arterial CO_2 tension to values less than 2 mm Hg, because CO_2 is carried with nearly equal efficiency in water as in air. With the knowledge of the O_2 and CO_2 dissociation curves, the whole gas exchange of fish can be described on one single O_2–CO_2 diagram from the point of the inspired gas tensions to that found in the venous blood of the tissues. Author

N64-17958 School of Aerospace Medicine, Brooks AFB, Tex.

URINE EVACUATING SYSTEM FOR USE IN FULL-PRESSURE SUITS

Sidney T. Lewis and Leonard Harris Mar. 1964 9 p
(SAM-TDR-64-13; AD-433079)

A urine elimination system was designed and tested for use with full-pressure suits. This device utilizes differential pressures as the main principle, causing the urine flow. The device was used on 19 flights in the low-pressure chamber at altitudes varying from sea level to 75,000 ft without one failure. With minor modifications this device can be used on any spacesuit and is a practical, comfortable, economical means of removing urine from the suit. Author

N64-17963 School of Aerospace Medicine, Brooks AFB, Tex.

SIMULATION WITH CARBON PARTICLES OF BACTERIAL INVASION OF HUMAN GINGIVAL TISSUES

William A. Gibson and Ira L. Shannon Feb. 1964 8 p refs
(SAM-TDR-64-4; AD-433105)

Carbon particles as a suspension of lamp-black powder in physiologic saline were used to simulate the size range and concentration of bacteria as they occur in the gingival sulcus. Gingival strip biopsies were taken from 24 systemically healthy, young adult males with minimal gingival inflammation. For 12 of the subjects, a thorough tooth scaling was performed in the presence of the carbon particles whereas the remaining 12 subjects, serving as controls, received no dental treatment of any type. In the unscaled group, no carbon particles were found in the underlying connective tissue, indicating that the biopsy procedure and tissue processing did not produce artifacts. Carbon particles were found, however, in the underlying connective tissues of all subjects in the scaled group. The distribution of the carbon particles was identical to the distribution of bacteria reported in previous histologic studies purporting to demonstrate active bacterial invasion of human gingiva. Author

N64-17973 Joint Publications Research Service, Washington, D.C.

SOME PROBLEMS OF THE MACROMOLECULAR STRUCTURE OF RIBONUCLEIC ACIDS

7 Apr. 1964 18 p refs Transl. into ENGLISH of excerpts from the book "Nekotoriye Probl. Makromolekul. Struktury Ribonukleinovykh Kislot", Moscow, Publ. House of the Acad. of Sci. USSR, 1963
(JPRS-24068; OTS-64-31007) OTS: $0.50

Research that led to the isolation of RNA is reviewed. It was found that RNA from TMV (tobacco mosaic virus), as well as from other viruses of the ribonucleoprotein type, have a similar molecular weight, about $2 \cdot 10^6$. Ribosomal RNA was found to have a molecular weight of 10^6. Studies to determine the sedimentation coefficients of RNA components are compared. A table presents the sedimentation coefficients and molecular weights of high-polymer RNA from TMV, *E. coli*, hare, and pea. The molecular-weight determinations of the soluble and informational RNA fractions are also discussed. Studies of the chain configurations of ribosomal RNA consider the spiral sections and the internal ribosomal packing of chains. The relationship of the RNA macrostructure to the biological functions of molecules is still incompletely understood. E.K.R.

N64-17976 Joint Publications Research Service, Washington, D.C.

INTERPRETATION OF NUCLEOTIDE SEQUENCE IN CONVEYING RIBONUCLEIC ACIDS

V. G. Tumanyan and L. L. Kiselev 8 Apr. 1964 13 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 8, no. 2, 1963 p 147–153
(JPRS-24086; OTS-64-31015) OTS: $0.50

A method is described for the reconstruction (determination) of initial nucleotide sequence in T-RNA following splitting by specific methods (enzymes and chemical agents). It is shown that, in general (without restricting the nature of the sequence), the use of four fission methods (specific for each of the four nucleotides) does not permit reconstruction of the initial sequence. In the case of certain statistical sequences, as well as for certain nonstatistical sequences, decoding may be achieved by using three or even two fission methods. Author

N64-17977 Joint Publications Research Service, Washington, D.C.

THE DOSE RATE OF PENETRATING ELECTRONS OF THE OUTER BELT

Ye. Ye. Kovalev and A. V. Larichev 8 Apr. 1964 7 p refs Transl. into ENGLISH of an excerpt from Vopr. Dozimetr. i Zashchit. ot Izluch. (Moscow), no. 2, 1963 p 105–108
(JPRS-24099; OTS-64-31025) OTS: $0.50

The absorbed dose rate of electrons with energies from $E_{0,min}$ to $E_{0,max}$ behind shielding of thickness d may be determined approximately by the formula

$$P_e(d) = 0.8 \times 10^{-8} \int_{E_{0,min}}^{E_{0,max}} N(E_0) \cdot E_0 / R(E_0)\, e^{-\mu(E_0)d} \cdot dE_0$$

where $R(E_0)$ is the mean free path of an electron with energy E_0 in biological tissue, g/cm^2; $\mu(E_0) = 0.693/\Delta(E_0)$ is the attenuation factor for electrons with energy E_0; $\Delta(E_0)$ is the half-value layer in the shielding material. Computations of the dose contribution from components of the outer-belt electron spectrum show that the electron dose rate drops very rapidly with increased thickness of the shielding. Computations of dose rate for different thicknesses of shielding show that, with small thicknesses ($d < 1.0$ g/cm^2), the principal contribution to the

radiation dose is made by hard electrons; with thicknesses of $d > 1.0\ g/cm^2$, the principal contribution to the dose is made by brehmsstrahlung. Author

N64-18041 Whirlpool Corp., St. Joseph, Mich.
HUMAN WASTE COLLECTION AND STORAGE DURING AEROSPACE FLIGHT Technical Documentary Report, 1 Jun. 1962-20 May 1963
Norman G. Roth, John J. Symons, Dave Cohen, and Robert B. Wheaton Wright-Patterson AFB, Ohio, Biomedical Lab., Feb. 1964 78 p refs
(Contract AF 33(657)-9131)
(AMRL-TDR-64-3; AD-433574)

An evaluation of techniques for human waste receiving, collection, and storage during an aerospace mission, with the crewman wearing, or not wearing, a pressure protective garment is presented. Laboratory models, utilizing the most promising techniques, were designed, fabricated, and evaluated. A centrifugal urinal, powered by a hand-wound spring motor, was developed for urine collection. A disinfectant dispenser operable in zero gravity and a spherical bladder-equipped urine storage tank with means for addition of disinfectant were developed. A flexible plastic in-suit urinal was fabricated, with means for discharging collected urine into the centrifugal urinal. A flexible plastic collector for fecal matter, held in place by a body harness and containing a disinfectant for stabilization purposes, was developed, as was a storage box for containment of used collectors. Author

N64-18056* Brandeis U., Waltham, Mass.
NEW APPROACHES TO BACTERIAL TAXONOMY
J. Marmur, S. Falkow (Walter Reed Army Inst. of Res., Washington D.C.), and M. Mandel (Massachusetts U., Amherst) Repr. from Ann. Rev. Microbiol., v. 17, 1963 p 329–372 refs
(NASA Grant NsG-375)

This review considers some of the new findings in bacterial genetics and biological polymers that may ultimately have a bearing on the classification of microorganisms. The remainder of the paper, after a short introduction, is divided into three sections: "Genetic Transfer," "Informational Macromolecules," and "Summary." An extensive list of the references cited is appended. The section entitled "Genetic Transfer" includes these topics: "Transformation," "Transduction," "Conjugation," "Phage Conversion," "Sex-duction," and "Genetic Transfer in Nature." The section on "Informational Macromolecules" includes "Deoxyribonucleic Acid," "Ribonucleic Acid," and "Proteins." In the "Summary," the author states a general lack of conflict between the reported findings and the existing bacterial classifications, and suggests a utility for these findings in sharpening the guidelines for taxonomists. D.E.W.

N64-18062 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
BINAURAL INTERACTION IN THE ACCESSORY SUPERIOR OLIVARY NUCLEUS OF THE CAT – AN ELECTROPHYSIOLOGICAL STUDY OF SINGLE NEURONS
Joseph L. Hall, II (Ph. D. Thesis) 22 Jan. 1964 88 p refs
(Contract DA-36-039-SC-78108; Grant DA-SIG-36-039-61-G14; NSF Grant-16526; NIH Grant MH-04737-03)
(MIT-TR-416; AD-430953)

In an effort to understand the neural encoding of binaurally presented stimuli, clicks were presented through earphones to the two ears of Dial-anesthetized cats. The electrical response activity of single nerve cells in the accessory nucleus of the superior olive was studied. Stimulus parameters investigated include interaural time difference, interaural intensity difference, and average intensity. A model by which judgments of image localization are obtained on the basis of patterns of activity in the accessory nuclei is suggested. In the model, the position of the fused virtual image is determined by a comparison of the amount of response activity in the left and right accessory nuclei. Incorporation of empirical data into the model yields predictions that are in quantitative agreement with results of human psychophysics. The model predicts that the virtual image should be localized toward the side receiving more intense or prior stimulation. Author

N64-18084 Joint Publications Research Service, Washington, D.C.
HISTOCHEMICAL AND ULTRASTRUCTURAL CHANGES OF RECEPTOR CELLS OF THE UTRICLE UNDER CONDITIONS OF AN ALTERED GRAVITATION FIELD
Ya. A. Vinnikov, O. G. Gazenko, L. K. Titova, I. V. Osipova, and A. A. Bronshteyn 24 Mar. 1964 10 p refs Transl. into ENGLISH from Doklady Akad. Nauk SSSR (Moscow), v. 153, no. 2, 1963 p 450–453
(JPRS-23837; OTS-64-21877) OTS: $0.50

Histochemical and electron-microscopic studies of the gravity receptor cells of the utricle of guinea pigs, subjected to radial acceleration, are reported. The guinea pigs were sacrificed after one, two, or three 3-minute rotation sessions in the dorsum-chest position, at a radial acceleration of 10 g, with 5-minute intervals between sessions. The changes observed indicate that ribonucleic acid (RNA), in the form of ribosomes, filters through the nuclear membrane into the cytoplasm, where the RNA granules induce the formation of an endoplasmic net around themselves. This egress of RNA from the nucleus is shown to be associated with intensification of the protein-synthesis processes in the cytoplasm as a result of increased protein expenditure during acceleration. The direction of the nucleolar RNA egress was found to coincide with the direction of the vector of the gravitational field. M.P.G.

N64-18085 Joint Publications Research Service, Washington, D.C.
CHANGES IN CERTAIN PHYSICO-CHEMICAL PROPERTIES OF CEREBRAL PROTEINS UNDER EXCITATION OF NERVOUS ACTIVITY
Ye. F. Ivanenko and V. P. Dunayeva 9 Apr. 1964 12 p refs Transl. into ENGLISH from Ukr. Biokhim. Zh. (Kiev), v. 36 no. 1, Jan. 1964 p 72-79
(JPRS-24119; OTS-64-31035) OTS: $0.50

During the first and second convulsive attacks caused by camphor, the sorption activity of the brain tissue insignificantly increases in comparison with the control. Under these conditions, there is a rise in the degree of swelling for the brain colloids, and the amount of water in the brain increases. In comparison with the norm, there is virtually no change in the amount of the SH-groups in the summary proteins, the alcohol number, and the viscosity of the brain colloids. A trend is noted towards a reduction in the solubility of the brain proteins in the IEZ during the convulsive attacks caused by camphor. Author

N64-18094 Los Alamos Scientific Lab., N. Mex.
HEALTH PHYSICS BIBLIOGRAPHY ON TRITIUM
Donald A. Mc Kown, comp. 25 Mar. 1964 84 p refs
(Contract W-7405-ENG-36)
(LAMS-2946) OTS: $2.25

A list of 87 papers with abstracts is given. The papers were selected to cover those aspects of the subject that would be of interest to monitoring and health physics personnel involved in radiation protection work. A few bibliographies are listed. Author

N64-18096 Joint Publications Research Service, Washington, D.C.

EFFECT OF INJECTION OF BONE MARROW CELLS UPON MORPHOLOGICAL MANIFESTATIONS OF EXPERIMENTAL INFLUENZA IN IRRADIATED ANIMALS

N. A. Maksimovich and O. P. Lebedeva 6 Apr. 1964 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 4, 1963 p 950–953

(JPRS-24056; OTS-64-31000) OTS: $0.50

An investigation was made of the morphological reaction of the internal organs of mice, principally of the lungs, in response to therapy with bone marrow. These mice had been subjected to general irradiation with X-rays and infected with influenza. The morphological changes in influenza of irradiated animals differed sharply from those present in ordinary experimental influenza. In addition to damage to the epithelium of the bronchi, an interstitial reaction is characteristic, and is accompanied by perivascular and peribronchial infiltration and the presence of leukocytes in the serous exudate. In irradiated animals, the hemorrhagic component predominated and occupied a leading place in all stages of the experimental influenza infection. The administration, once or twice, of bone marrow, noticeably changed the morphology of the influenza process. This process then became similar to that in nonirradiated animals, acquiring all traits characteristic for experimental influenza. The only difference was that cell disintegration, both in the lumen of the bronchi and in the exudate filling the alveoli, was more pronounced than in the influenza of nonirradiated mice. R.T.K.

N64-18114 Joint Publications Research Service, Washington, D.C.

CHANGES IN THE STRONTIUM-90 CONTENT OF FOOD PRODUCTS AFTER COOKING

Z. V. Dubrovina and O. M. Belova 10 Apr. 1964 7 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 2, Feb. 1964 p 40–43

(JPRS-24139; OTS-64-31050) OTS: $0.50

The passage into broth of strontium-90 from bones, meat, potatoes, and cabbage with various modes of cooking was studied. It was found that the amount of strontium-90 passing into broth from bones constituted only a fraction of 1 percent, while in the instance of meat it was 50% to 60% and in that of potatoes and cabbage it was 20%. The duration of thermal treatment and the changes in the pH level had no effect on passage of radioactivity from product to solution. The addition of calcium and magnesium salts tended to increase strontium-90 passage into the broth. Seven times more strontium-90 was removed from peeled potato than from potato cooked in the jacket. Author

N64-18115 Joint Publications Research Services, Washington, D.C.

CHEMISTRY OF BRAIN FUNCTION

N. I. Grashchenkov 10 Apr. 1964 13 p Transl. into ENGLISH from Priroda (Moscow), v. 53, no. 2, 1964 p 10–17

(JPRS-24151; OTS-64-31060) OTS: $0.50

Mediators of neural excitation, such as acetylcholine, are discussed, not only as transmitters of nerve impulses but also as humoral regulators of physiological processes in the body. The relation of these chemical mediators and other chemical substances detectable in various brain formations to the functional state of the brain is presented. The evidence that the presence of these substances in different concentrations in different portions of the brain has a definite relationship to the specific functional properties of these formations is given. The determination of the biological activity of the blood, in particular, the ratio between the sympathomimetic and parasympathomimetic metabolites, is proposed as the most adequate method for studying the autonomic nervous system under experimental and clinical conditions. R.T.K.

N64-18138 Joint Publications Research Service, Washington, D.C.

THE NATURE OF ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF AMINO ACIDS AND PROTEINS SUBJECTED TO THE ACTION OF GAMMA RADIATION AND LIGHT

M. K. Pulatova and O. A. Azizova 1 Apr. 1964 11 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 9, no. 1, 1964 p 33–39

(JPRS-23983; OTS-64-21960) OTS: $0.50

The paramagnetic centers of γ-irradiated sulfur-containing amino acids and polypeptides at 77° K represent free radicals with localization of the unpaired electron on a sulfur atom. The hyperfine structure of the EPR spectra of such compounds is determined by the influence of the hydrogen nuclei closely situated to the sulfur atom. At room temperature a free radical is formed: $R\text{-}(S\ldots S)^{+}\text{—}R$, common to cystine, cysteine, and glutathione. The illumination of γ-irradiated sulfur-containing amino acids and glutathione at 77° K leads to a considerable reduction of the number of radicals responsible for the cystine EPR signal. The EPR spectrum of γ-irradiated protein at 77° K represents the sum of two signals: singlet and triplet. The latter signal is due to the sulfur-containing amino acid radical. Illumination of γ-irradiated proteins produces an increase in the cystine EPR signal at 77° K. Author

N64-18148 Defence Standards Labs., Maribyrnong (Australia)

FUNGAL GROWTHS IN AVIATION FUEL SYSTEMS, PART 4: FUNGI IN AVIATION FUEL SYSTEMS IN AUSTRALIA AND THE FAR EAST

G. F. Hazzard Oct. 1963 55 p refs

(Rept. 252)

This report includes detailed surveys of fungal occurrence in aircraft utilizing integral fuel tanks and in Australian and Far Eastern airfield fueling systems. The predominant fungus is identified as *Cladosporium resinae* Lindau (de Vries). Observations are made on its growth under various conditions and on the appearance of fungal contamination in aircraft and ground systems. The report then describes methods by which the fungal contamination of fuels can be reduced without the use of biocidal additives and concludes with a summary of the much improved situation in Australian fuel systems. Author

N64-18206 Joint Publications Research Service, Washington, D.C.

POSTRADIATION RESTORATION OF YEAST CELLS IRRADIATED UNDER AEROBIC AND ANAEROBIC CONDITIONS

V. S. Barsukov et al 31 Mar. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 5, 1963 p 1199–1201

(JPRS-23945; OTS-64-21942) OTS: $0.50

The presence of oxygen during irradiation of radiosensitive cells was found to result in an increase in the degree of injury to the mass cytoplasmic structures of the cell responsible for restoration. The restoration rate was found to decrease. R.T.K.

N64-18318 Joint Publications Research Service, Washington, D.C.

THE POSSIBILITY OF INTERTRYPTOPHAN MIGRATION OF ENERGY IN PROTEIN SYSTEMS

S. V. Konev et al. 2 Apr. 1964 8 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 9, no. 1, 1964 p 124–127 (JPRS-23991; OTS-64-21962) OTS: $0.50

The migration of energy between tryptophan radicals brought close together in the protein macromolecule, to the distance characteristic of concentrated tryptophan–glycerine solution of the order of 10^{-1} M, was investigated. To supplement this investigation, the polarization fluorescence spectra of human-serum albumin and of pepsin, both in solution and in a film, were studied. Aqueous solutions of albumin and pepsin were used. The spectral curves show that even in solid films, where any possibility of rotational motions both of the entire macromolecule as a whole, and of its individual units, is eliminated, the degree of polarization of the pepsin is significantly reduced in comparison with free tryptophan over the entire range of the spectrum. At the same time, the degree of polarization of the luminescence of proteins in the film and solution are close. This gives evidence against the possibility of the migration of energy between tryptophan radicals belonging to neighboring macromolecules in the film. Similar principles were also obtained for albumin. I.v.L.

N64-18328 Joint Publications Research Service, Washington, D.C.

RECENT STUDIES ON NUCLEIC ACIDS

7 Apr. 1964 23 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 8, no. 1, 1963 p 19–27, 124, and 140–141 (JPRS-24070; OTS-64-31008) OTS: $0.75

CONTENTS:

1. SOME PHYSICO-CHEMICAL ASPECTS OF SINGLE-STRAND DESOXYRIBONUCLEIC ACID (DNA) N. I. Ryabchenko, D. M. Spitkovskiy, and P. I. Tseytlin p 1–14 refs (See N64-18329 10-16)

2. RIBONUCLEIC ACID (RNA) —TRANSMITTER AND KEY TO HEREDITARY INFORMATION V. G. Tumanyan, N. G. Yesipova, and N. S. Andreyeva p 15–16 (See N64-18330 10-16)

3. ON THE PROBLEM OF THE QUASIMONOSPIRAL STATE OF DESOXYRIBONUCLEIC ACID (DNA) WITHIN THE MAKE-UP OF DESOXYRIBONUCLEOPROTEIN (DNP) (ON THE MECHANISM OF DNA REDUPLICATION) D. M. Spitkovskiy p 17–20 refs (See N64-18331 10-16)

N64-18329 Joint Publications Research Service, Washington, D.C.

SOME PHYSICO-CHEMICAL ASPECTS OF SINGLE-STRAND DESOXYRIBONUCLEIC ACID (DNA)

N. I. Ryabchenko, D. M. Spitkovskiy, and P. I. Tseytlin *In its* Recent Studies on Nucleic Acids 7 Apr. 1964 p 1–14 refs (See N64-18328 10-16) OTS: $0.75

The physicochemical properties of s-DNA isolated from thymus n-DNA are discussed. It is shown that single-strand DNA has been isolated, and that it can be differentiated from two-strand native and denatured structures. Production of the single-strand structure was determined by degradation kinetics, in the presence of distinctly pronounced tests of flexibility, thermally conditioned increases in viscosity, and corresponding drops in molecular weight. P.V.E.

N64-18330 Joint Publications Research Service, Washington, D.C.

RIBONUCLEIC ACID (RNA) – TRANSMITTER AND KEY TO HEREDITARY INFORMATION

V. G. Tumanyan, N. G. Yesipova, and N. S. Andreyeva *In its* Recent Studies on Nucleic Acids 7 Apr. 1964 p 15–16 (See N64-18328 10-16) OTS: $0.75

The modern diagram (code) of protein biosynthesis presupposes a specificity of function of nucleic acids participating in the biosynthesis, this specificity may be related only to the structural peculiarities of their molecules. It has been shown that the configuration of such polymeric molecules is thermodynamically stable in solution and, consequently, is determined by a succession of bases. It is known that soluble RNA is characterized by a very high degree of spiralization. Ribosomal RNA is also characterized by spirals to a considerable extent. It is obvious that those areas of informational RNA that contain code triplets must not be spiralized, at least not on the ribosome in the process of biosynthesis. It can be assumed that the nature of succession of nucleotides in the information of RNA causes absence of spiralization in the areas containing key triplets. Therefore, there must be fewer GC pairs (more stable) in the code than UA pairs; thus, the U and A content must be different from that normally assumed in the code, these being the ones most frequently encountered in the nucleotides. P.V.E.

N64-18331 Joint Publications Research Service, Washington, D.C.

ON THE PROBLEM OF THE QUASIMONOSPIRAL STATE OF DESOXYRIBONUCLEIC ACID (DNA) WITHIN THE MAKE-UP OF DESOXYRIBONUCLEOPROTEIN (DNP) (ON THE MECHANISM OF DNA REDUPLICATION)

D. M. Spitkovskiy *In its* Recent Studies on Nucleic Acids 7 Apr. 1964 p 17–20 refs (See N64-18328 10-16) OTS: $0.75

The DNP insolubility hinders investigation of its physicochemical parameters, under most interesting conditions from the biological point of view. As a result, the usual physicochemical investigations (light dispersion, viscosity, ultracentrifugation, hypochromic effect, etc.) have to be conducted either in water or in one-mole NaCl, with the assumption that DNP properties have been adequately investigated under physiological conditions. One of the possible methods of investigation of DNP in the condensed phase, in the presence of the physiological ionic strength of the environment, is the study of structural–mechanical properties of oriented DNP formations. From experimental data, it is concluded that one of the functions of DNP protein is apparently to break down hydrogen bonds between bases in DNA, and to transform the latter into a quasi-monospiral state without special mechanisms (enzymes, etc.). P.V.E.

N64-18334 Joint Publications Research Service, Washington, D.C.

THE EFFECT OF RADIATION INACTIVATION OF NUCLEI ON THE SYNTHESIS OF INFORMATIONAL RIBONUCLEIC ACID IN EMBRYOS OF FISH (MISGURNUS FOSSILIS)

N. V. Belitsina et al. 31 Mar. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 153, no. 5, 1963 p 1204–1206

(JPRS-23944; OTS-64-21941) OTS: $0.50

Irradiation causes complete cessation of DNA synthesis. However, the synthesis of high-molecular-weight mRNA is not discontinued at all, and evidently, is not even decreased. Thus, as the formation of high-molecular-weight mRNA is not impaired and nuclear morphogenetic activity is not depressed as a result of the effect of the dosage of irradiation used (50 kr), then it is obvious that synthesis of high-molecular-weight mRNA in the nucleus is not identical with the morphogenetic function of the nucleus. This agrees completely with the conclusion previously made on the basis of a study of mRNA synthesis in

different phases of development. It can be believed that high-molecular-weight mRNA, appearing as a typical rapidly exchanging fraction of RNA in animal cells, carries out quite different functions, not having a direct connection with the process itself, of the transmission of genetic information from nucleus to cytoplasm. I.v.L.

N64-18348 Rochester U., N.Y.
STRONTIUM-90 TOXICITY IN RAT EMBRYO
B. J. Hopkins, G. W. Casarett, L. W. Tuttle, and R. C. Baxter
21 Feb. 1964 20 p refs
(Contract W-7401-ENG-49)
(UR-639)

Gestating rats were injected intravenously with doses of 191 microcuries or 382 microcuries of strontium-90 on the 2nd, 10th, and 17th days postconception. Examination of implantation sites on the 20th day postconception showed that the injection of strontium-90 on day 2 postconception caused a significant increase in fetal mortality and growth retardation, greater in degree after the larger dose, and that injection of strontium-90 on the 10th postconception day retarded growth and increased mortality (slightly) only after the larger dose. The maternal hematocrit was lowered significantly at both dose levels following strontium-90 injection on either the 2nd or 10th day postconception, and this effect was greater in those injected on day 2 postconception. The hematocrit of fetuses of strontium-injected rats was decreased slightly, but not significantly. There was an increased daily cumulative mortality in offspring of strontium-treated rats during the first week of life, but this was no longer evident by one month of age. Author

N64-18398 Joint Publications Research Service, Washington, D.C.
SURGICAL TREATMENT OF THERMAL BURNS
V. D. Bratus' 30 Mar. 1964 59 p Transl. into ENGLISH from the book "Khirurgicheskoye Lecheniye Termicheskikh Ozhogov" Kiev, 1963 p 3, 5–11, 231–250, 337–346, and 383
(JPRS-23933; OTS-64-21935) OTS: $1.50

A thorough study of burn patients during their entire illness made it possible to confirm that pathological changes, as well as protective compensatory processes in the organism, develop according to definite states. Each stage of the disease has its own, most-characteristic changes. Observations have shown that the probability of clinical manifestation of these stages of burn disease depends not only on the seriousness of the burn, reactivity of the organism, age, and concomitant diseases, but also to a considerable extent, on the effectiveness of employed therapy. Therapy that has been found to be effective during the various stages of burn disease is discussed. The results of a search for proteolytic enzymes capable of rapid and selective lysis of necrotized tissues of the skin are discussed. Certain enzymes of the digestive glands, as well as numerous enzymes grown from mold fungi and anaerobic microorganisms, were used. The most active filtrates from the isolated purified enzyme possessed no proteolytic action of sufficient strength for use instead of surgery. R.T.K.

N64-18400 Joint Publications Research Service, Washington, D.C.
ELECTRIC STIMULATION OF THE HEART
S. S. Grigorov et al 8 Apr. 1964 7 p refs Transl. into ENGLISH from Klin. Med. (USSR), v. 43, no. 2, Feb. 1964 p 124–126
(JPRS-24083; OTS-64-31013) OTS: $0.50

A patient was clinically diagnosed as having total atrioventricular block with Morgan–Adams–Stokes seizures. The patient was treated effectively with electrical stimulation of the heart. R.T.K.

N64-18409 Rochester U., N.Y.
THE EFFECT OF INHALED RADON ON THE SURVIVAL, BODY WEIGHT AND HEMOGRAM OF THE MOUSE FOLLOWING MULTIPLE EXPOSURES
Donald A. Morken 27 Mar. 1964 74 p refs
(Contract W-7401-ENG-49)
(UR-624)

Mice exposed to daughter-free radon atmospheres by inhalation in one or several exposures exhibited a life-span shortening proportional to total accumulated dose. One-half of the lethality injury produced was repaired within a period of 2 weeks, and the extent of repair was independent of the dose fractionation. These mice demonstrated a weight loss proportional to total accumulated dose, independent of the dose fractionation. The blood picture evidenced injury proportional to dose fractions, when separated by 2 weeks, and rapid recovery. The red blood cell count was permanently depressed by a fixed amount following the first exposure, regardless of dose, and was not further influenced by subsequent doses. Author

N64-18410 Joint Publications Research Service, Washington, D.C.
EFFECTS OF SOME CHEMICAL AGENTS ON LIVING MATTER
6 Apr. 1964 13 p refs Transl. into ENGLISH of 2 articles from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 3, 1963 p 737–743
(JPRS-24050; OTS-64-21994) OTS: $0.50

CONTENTS:

1. THE EFFECT OF ACRYLAMIDE AND ITS HYDROGENATED DERIVATIVE ON IRRADIATED BIOLOGICAL SYSTEMS Yu. P. Kozlov and T. N. Kalabykha p 1–4 refs (See N64-18411 10-16)
2. THE EFFECT OF HEAVY WATER ON DNA AND PROTEIN PROPERTIES V. V. Grechko et al p 5–10 refs (See N64-18412 10-16)

N64-18411 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF ACRYLAMIDE AND ITS HYDROGENATED DERIVATIVE ON IRRADIATED BIOLOGICAL SYSTEMS
Yu. P. Kozlov and T. N. Kalabykha *In its* Effects of Some Chemical Agents on Living Matter p 1–4 refs (See N64-18410 10-16)

The influence of aqueous solutions of acrylamide and its hydrogenated derivative, amide of propionic acid, on the degree of grafting of polymers on irradiated wheat seeds, on the survival rate of irradiated diploid yeast cells, and on the degree of hemolysis of irradiated human erythrocytes was investigated. It was found that, in all cases, the introduction of acrylamide into the biological systems led to inhibitions in these systems of the free-radical states arising from irradiation, whereas the introduction of the hydrogenated derivative had a completely opposite effect. E.W.

N64-18412 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF HEAVY WATER ON DNA AND PROTEIN PROPERTIES
V. V. Grechko, R. N. Maslova, L. S. Shkarenkova, Ye. I. Silina, and Ya. M. Varshavskiy *In its* Effects of Some Chemical Agents on Living Matter p 5–10 refs (See N64-18410 10-16)

A study was made of heat and acid-base denaturization of DNA in H_2O and D_2O solutions. The effect of D_2O on the reaction of antigens with antibodies was also investigated. E.W.

N64-18421* Naval School of Aviation Medicine, Pensacola, Fla.
EFFECTS OF EXPOSURE TO CONTINUOUS ROTATION ON NYSTAGMUS PHASE SHIFT
Jorma I. Niven and W. Carroll Hixson 7 Oct. 1963 20 p refs
(NASA Order R-47)
(NASA CR-53618; Rept. 87) OTS: $1.60 ph

The effect of 12 days' continuous exposure to constant rotation at 10 rpm on the steady-state response of the oculovestibular system to sinusoidal angular acceleration was evaluated from corneoretinal potential recordings obtained at rotation frequencies of 0.025 to 0.20 cps with equal magnitudes of peak velocity. Values of the damping-stiffness ratio of the cupula-endolymph system, estimated from nystagmus phase shift at 0.025 cps, were found to be consistent with those obtained by conventional cupulometry and were not significantly affected by the stress of the rotating environment.
Author

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-17865 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION DEVELOPMENT OF A SILICON PLANAR EPITAXIAL TRANSISTOR WITH A MAXIMUM OPERATING FAILURE RATE OF 0.001% PER 1000 HOURS AT A CONFIDENCE LEVEL OF 90% AT 25°C Fifth Quarterly Report, 1 May 1963–31 Jul. 1963
Paul Greer [1963] 22 p
(Contract DA-36-039-SC-86728)
(AD-433710) OTS: $2.60

The power step-stress, operating life, and environmental testing of the Al-Al-Au metallization process are covered, and the results are compared with the older metallization processes. An acceleration factor was determined between step-stress levels and the level for which the .001%/1,000 hr objective was established. Author

N64-17867 TRW Semiconductors, Inc., Lawndale, Calif.
RELIABILITY THRU PROCESS IMPROVEMENT (2N1506)–PRODUCTION ENGINEERING MEASURE Fifth Quarterly Report, 30 Jun. 1963-30 Sep., 1963
R. Austin, G. Kamienski, P. Kellow, J. Logan, I. Massaron et al [1963] 22 p
(Contract DA-36-039-SC-86742)
(TRW-3000-43-Q-5; AD-434096)

Conditions are ready for starting the production run. Two areas, lead attachment and encapsulation, require additional engineering effort. Recent linear life-test results are very encouraging and show low failure rate. The failures are being investigated, and information is being utilized for additional process improvements. Author

N64-17925 RAND Corp., Santa Monica, Calif.
ON INCREASING THE OPERATING LIFE OF UNATTENDED MACHINES
I. S. Reed and D. E. Brimley Nov. 1962 26 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3338-PR; AD-290472)

Tables are presented showing the results of two methods of using redundancy to increase the life of unattended machines. The methods are: (1) the duplication of multiplexing of complete units; and (2) the use of modules or subunits as replacements. If perfect switching is assumed, the second method is more effective in increasing the machine mean life.
Author

N64-18013 Rocketdyne, Canoga Park, Calif.
DEVELOPMENT OF HIGH-ENERGY SOLID PROPELLANT FORMULATIONS VOLUME 2: BERYLLIUM PROPELLANT HANDLING MANUAL Final Summary Report
K. R. Regier, R. B. Gordon, D. R. V. Golding, J. R. Glantz, H. Weiss et al Jan. 1964 64 p refs
(Contract AF 04(611)-8179)
(RPL-TDR-64-10, Vol. 2; AD-433006)

This report outlines the purpose, objectives, and results of the industrial hygiene program. A detailed description of the facilities and methods utilized for the control of beryllium during the production and static test firing of beryllium-containing propellants is presented. Environmental sampling data, as well as the data collected from a downwind sampling network, are included. The data demonstrate the feasibility of producing and static test firing beryllium-containing propellants.
Author

N64-18044 Mechanical Technology Inc., Latham, N.Y.
EXPERIMENTAL INVESTIGATION OF TWO-PHASE FLOW IN THRUST BEARINGS – PART II COOLED ROTATING SURFACE BEARING
F. K. Orcutt Jul. 1963 28 p refs
(Contract Nonr-3731(00) FBM)
(MTI-63TR28; AD-418406)

The cooled-rotor version of the externally pressurized, steam-lubricated thrust bearing behaved in approximately the same fashion as its cooled-stator predecessor. Rotational speed has some influence on load-carrying capacity and on the rate at which heat is transferred to the coolant. The increase in heat loss from the steam in the film was apparently responsible for lowering the load-carrying capacity. Collapse of the bearing, at some limiting load, still occurs at all speeds, and the actual collapse still appears to be accompanied by the formation and inward movement of a bridging boundary. Any effects of the speed of rotation on other aspects of the bearing behavior, such as pressure and temperature distribution, were too small to be clearly distinguishable. Calculations of pressure distribution, assuming a single-phase lubricant having the properties of dry steam, and assuming both flat and warped surfaces, suggest that thermally induced distortion has reinforced the effects of lubricant mass transfer, from the vapor phase to the liquid phase within the bearing gap, on pressure distribution and load capacity. However, distortion alone cannot explain certain experimental observations, including sudden collapse of the bearing at some limiting load. I.v.L.

N64-18045 Mechanical Technology Inc., Latham, N.Y.
LUBRICATION IN THE TURBULENT-FLOW REGIME – EXPERIMENTAL STUDIES ON A PARTIAL ARC PAD
F. K. Orcutt [1963] 38 p refs
(Contract Nonr-3731(00) FBM)
(MTI-63TR40; AD-421048)

Results of these studies include: (1) The entrance of entrained air into the bearing film results in a sudden, substantial

reduction in minimum film thickness. The bearing behaves in much the same fashion as one that is starved of lubricant. (2) The fully submerged arc bearing apparatus is capable of producing accurate bearing-locus data for those conditions of operation that result in eccentricity ratios above about 0.5. (3) The transition from laminar to unstable flow results in bearing-locus changes to lower eccentricity ratio and to a larger attitude angle than would be the case had laminar flow persisted. (4) A comparison of experimental measurements with the available turbulent-flow lubrication theory indicates that the empirically determined factor in the theory varies with bearing arc length as well as with Reynolds number and eccentricity. (5) The onset of flow transition can be identified from close observation of the bearing-locus measurements. The transition speeds observed were found to compare quite well with the criterion for transition in an eccentric bearing developed by DiPrima. I.v.L.

N64-18058 General Dynamics/Fort Worth, Tex.
EFFECTS OF ANDROFORMING ON MATERIAL PROPERTIES Final Report, 1 May 1961-18 Jun. 1963
C. D. Lantz and R. L. Jones Wright-Patterson AFB, Ohio. Mfg. Technol. Div.
(Contract AF 33(600)-42847)
(RTD-TDR-63-7-910; AD-430229)

The purpose of this project was to establish the forming parameters of the Model J Androform machine; to determine the effect of Androforming on material properties; and to establish operational data, correlating machine settings to part contour, in order to eliminate trial and error methods during machine setups. This report presents the experimental program undertaken to reach these objectives. Author

N64-18064 Texas Instruments, Inc., Dallas, Tex.
PRODUCTION ENGINEERING MEASURES TO IMPROVE TRANSISTOR RELIABILITY Quarterly Progress Report No. 4, Apr. 1, 1963-Jun. 30, 1963
Sam Mc Cleese, Doyce Briggs, and R. L. Petritz [1963] 27 p
(Contract DA-36-039-SC-86730)
(AD-434402)

The areas covered in this report are as follows: (1) material preparation; (2) thermal dissipation of package; (3) assembly; (4) cleaning techniques; (5) final preparation prior to assembly; (6) controlled formation of surface oxides; (7) welding; and (8) postweld conditioning. Author

N64-18065 Space-General Corp., El Monte, Calif.
PROJECT FIRST Monthly Progress Letter, 15 Jan.-15 Feb. 1963
J. F. Keville 18 Feb. 1963 15 p ref
(Contract AF 33(657)-10252)
(SGC-335-1; AD-434396)

Project First was undertaken to develop the fabrication of an inflatable reentry structure. This structure is proposed in the form of a Rogallo wing paraglider, which will descend through the atmosphere at initially hypersonic velocity and survive the aerodynamic loads and high material temperatures encountered. Activity to date has included a review of literature and of latest developments on suitable trajectories and materials of construction. Applicable trajectory and aeroheating data have been computed by manual means and by IBM 7090 computer programs. Preliminary stress and structural design calculations have been undertaken, and the basic paraglider configuration presented in the proposal appears to be suitable. Author

N64-18067 Du Pont de Nemours (E.I.) and Co., Baltimore, Md. Metals Center
REFRACTORY ALLOY FOIL ROLLING DEVELOPMENT PROGRAM Interim Report No. 1, 15 Jun. 1962-15 Sep. 1962
John Symonds Wright-Patterson AFB, Ohio, Manuf. Technol. Lab., [1962] 135 p refs
(Contract AF 33(657)-8912)
(AD-434397)

The state-of-the-art of the rolling of columbium, tantalum, and tungsten base alloys to foil is reviewed. Since the rolling of foil requires control of the entire processing sequence, consolidation, sheet rolling, properties of sheet, and factors such as fabricability and stage of development have been analyzed. Author

N64-18068 Mechanical Technology Inc., Latham, N.Y.
BEARING MATERIALS FOR PROCESS FLUID LUBRICANTS Progress Report No. 3
M. B. Peterson and F. F. Ling, Oct. 1963 29 p refs
(Contract Nonr-3731(00) FBM)
(MTI-63TR41; AD-420961)

An investigation was conducted into the nature of surface damage that resulted from high-speed sliding contacts. The first portion of the program consisted of an analytical temperature solution for transient case for two bodies in sliding contact. In exploratory studies of high-speed, short-time contacts, the following results were obtained: (1) Gold, bronze, and chrome plate gave the least surface damage of the materials tested that could be considered for high-temperature applications. (2) Considerable difference was noted in the damage that resulted in short-time contact at high speed in contrast to that which would be expected from longer sliding times. In certain cases the damage was more severe (tool steel) and, with others, less severe (titanium carbide, 440C stainless). Author

N64-18089 Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)
THREE-DIMENSIONAL MODEL MAKING: NUMERICAL METHODS USING THE FERRANTI TAPE-CONTROLLED MACHINE TOOL
B. W. Gregory Feb. 1964 17 p refs
(ARA Wind Tunnel Note 50)

The Ferranti tape control system is summarized, and numerical methods of interpolation and determining cutter centers corresponding to three-dimensional surfaces are described. Author

N64-18107* Stanford Research Inst., Menlo Park, Calif.
DESIGN DATA FOR PRESSURIZED GAS SYSTEMS
R. F. Muraca et al Nov. 1963 626 p refs
(NASA Contract NAS7-105; SRI Proj. PSU-4000)
(NASA CR-53393) OTS: $28.50 ph

Summaries of available information on the fundamental parameters governing the design of pressurized-gas systems for spacecraft are presented. The information is divided into the following areas: (1) space environment; (2) attitude-control theory; (3) nozzle performance; (4) storage efficiency; (5) zero-g considerations; (6) heat balance; (7) permeability theory; (8) properties of gases; (9) theory of vessel design; (10) pressurization systems; (11) materials; (12) reliability; (13) valves; and (14) rings and seals. P.V.E.

N64-18116 Ampex Corp., Redwood City, Calif.
GROOVED PLATE GAS LUBRICATED THRUST BEARINGS, WITH SPECIAL REFERENCE TO THE SPIRAL GROOVE BEARING
M. Wildmann Jan. 1964 44 p refs
(Contract Nonr-3815(00))
(RR-64-1; AD-434437)

The basic equations governing the behavior of spiral groove gas-lubricated thrust bearings are derived, and the assumptions made during this derivation are stated and explained. From these equations, expressions for load for spiral groove thrust bearings are obtained, and optimum performance curves are presented. Author

N64-18273 Texas Instruments, Inc., Dallas
DEVELOPMENT OF A TRANSISTOR DELIVERING AN OSCILLATOR OUTPUT OF 250 MILLIWATTS AT 1.5 GIGACYCLES Quarterly Progress Report No. 1, Jun. 19, 1963-Sep. 19, 1963
K. B. Landress 1 Oct. 1963 12 p
(Contract NObsr-89423)
(AD-420557)

The necessary glass and metal masks were designed, ordered, and received. The masks were checked for conformance to specifications. Single transistor structures were fabricated on various combinations of epitaxial material resistivity and thickness to determine the optimum combination. A technique for defining the deposited emitter material employing only photoresist operations was developed. Prototype models of the header proved to be mechanically deficient and are being suitably modified. Author

N64-18292* Aeronca Mfg. Corp., Middletown, Ohio
RESEARCH AND DEVELOPMENT OF S-IC HEAT SHIELD PANELS Monthly Report No. 9, Oct. 1963
D. Y. Potter 14 Nov. 1963 28 p
(NASA Contract NAS8-5221)
(NASA CR-53390; ER-741) OTS: $2.60 ph

The following areas of research and development are discussed: (1) heat-shield-panel braze quality metal-to-metal and core-to-metal areas; (2) analysis of metal-to-metal and core-to-metal voids in heat-shield panel—core-to-metal voids, metal-to-metal voids (short and long leg of the zee members); and (3) repair methods for metal-to-metal voids—mechanical fasteners, spot welds, and fusion welding. P.V.E.

N64-18311 Philco Corp., Lansdale, Pa.
PEM FOR TRANSISTOR MANUFACTURING PROCESS IMPROVEMENT Final Progress Report, 30 Apr. 1962-31 Dec. 1963
J. G. Sanders [1963] 202 p refs
(Contract DA-36-039-SC-86720)
(AD-433654)

The work for reliability improvement of the jet etch-type transistor through process improvements is reported complete, with all of the program objectives having been met. The report includes the overall processing specification for the improved transistor, and the applicable inspection and quality control plan. The method devised for accelerated testing and extrapolation of reliability levels under use conditions was effectively demonstrated. Accumulated data on transistors produced using the improved processes show that an acceleration curve having a slope equivalent to an activation energy of 19.6 kcal/mole is realistic for the improved device. The maximum operating rating of the improved transistor is reported as 150 mw at 25° C at a λ = 0.7%. This compares with 60 mw at 25° C at a λ = 5% for the original device. Author

N64-18316 General Electric Co., Auburn, N.Y.
A PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY FOR DIFFUSED SILICON CONTROLLED SWITCHES TYPES 2N689 Second Quarterly Progress Report, 1 Oct. 1963-31 Dec. 1963
J. N. Frank, R. C. Rome, H. Wawrousek, and W. R. Comstock [1963] 43 p refs
(Contract DA-36-039-AMC-03619(E))
(AD-434272)

Work in the following areas is discussed: (1) fabrication of the four-transducer ultrasonic torsional welder; (2) completion of the ultrasonic tubulation-seal process; (3) fabrication of all-diffused devices without gold doping; (4) continuation of experiments on the influence of dislocations in silicon crystals upon the electrical characteristics of the all-diffused 2N689 type device; and, (5) step stressing of the present alloy-diffused device. A PERT analysis depicts the progress of this program and provides certain conclusions on the work performed. Author

N64-18369 Texas Instruments, Inc., Dallas
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Quarterly Progress Report No. 4, 1 Feb.-30 Apr. 1963
P. Shankle et al [1963] 28 p
(Contract DA-36-039-SC-86730)
(AD-432001)

A nondestructive test to measure the resistivity of epitaxial layers has been developed. An automatic slice-cleaning machine is in use and has been incorporated as a production process. Excellent control of photoresist properties has been obtained by hydrolizing, centrifuging, and mixing to a constant viscosity all photoresist. The elimination of preforms has been accomplished by evaporating N-type doped gold on the collector side of the slice. P.V.E.

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-17858 Illinois U., Urbana
CYCLE DEPENDENT DEFORMATION BEHAVIOR OF CLOSE-PACKED METALS Technical Documentary Report, 1 Apr. 1961-Jul. 1963
C. E. Feltner Wright-Patterson AFB, Ohio, AF Materials Lab., Nov. 1963 90 p refs
(Contract AF 33(616)-8177)
(RTD-TDR-63-4149; AD-430011)

The phenomenon of cyclic stress-induced creep is investigated for copper, aluminum, and cadmium at room temperature and 78° K. In repeated tensile tests, varying the maximum load produces a set of strain versus cycle curves, which are similar to strain versus time curves obtained in ordinary static creep. The stress dependence of the minimum cyclic creep rate is satisfactorily described by a power function of stress. For combined creep and fatigue, a clear delineation is established between deformation processes that are time dependent and those that are cycle dependent. Comparison of the static and cyclic creep curves on the same strain–time diagram leads to the conclusion that the accumulation of strain during combined creep and fatigue loading is cycle dependent in the homologous temperature range $T/T_m<0.25$, time dependent in the range $T/T_m>0.5$, and both cycle and time dependent in the temperature range $0.25<T/T_m<0.5$. Author

N64-18106* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF MARAGING STEEL FOR APPLICATION TO SPACE LAUNCH VEHICLES Final Report
Z. P. Saperstein and W. V. Mixon Feb. 1964 276 p refs
(NASA Contract NAS7-214)
(NASA CR-53416; SM-43105) OTS: $17.50 ph

An investigation was undertaken to evaluate mechanical and metallurgical properties of 3/4-in.-thick airmelted 18Ni-7Co-5Mo alloy plate and of welds deposited in the alloy. The evaluations included determinations of the effects of aging heat treatment on the mechnical properties of welds and plate. Uniaxial tensile, plane strain fracture toughness (employing partial thickness crack specimens), hardness, and sustained load properties were studied. Metallurgical investigations included the use of novel electron fractographic methods. Such methods supplemented with electron diffraction and X-ray microprobe analysis techniques were employed for phase identification. The principal results of this investigation are summarized. Author

N64-18194 Massachusetts Inst. of Tech., Cambridge
INVESTIGATION OF SOLIDIFICATION OF HIGH STRENGTH STEEL CASTINGS Interim Summary Report, 9 Dec. 1962-30 Sep. 1963
[1963] 72 p refs
(Contract DA-19-020-ORD-5443(X))
(AMRA-CR-63-04/2; AD-432998)

The present work on low-alloy AISI 4340 steel was conducted as one phase of an extended program encompassing the study of microheterogeneities in steel castings and their effect on mechanical properties. The following general topics are treated: (1) determination of isoconcentration surfaces in columnar dendrites; (2) determination of the index of segregation in columnar dendrites; (3) analysis of morphology of columnar dendrites; (4) development of a simplified but geometrically realistic model of dendrites on which to base calculations of degree of homogenization to be expected in heat treatment; (5) calculation and measurement of degree of homogenization; and (6) determination of morphology of equiaxed dendrites. Author

N64-18199 Army Materials Research Agency, Watertown, Mass. Materials Engineering Lab.
EFFECT OF TEMPERING ON NOTCH PROPERTIES OF D6AC ALLOY STEEL SHEET
Robert N. Katz Dec. 1963 17 p refs
(AMRA-TR-63-35; AD-431311) OTS: $0.50

A study of the strength and notch properties of D6AC (consumable electrode, vacuum-melted Cr-Mo-V) steel sheet, 0.040-in. thick, was conducted to evaluate the effect of tempering for various test temperatures. Smooth tensile, edge-notched tensile, and precracked subsize Charpy specimens were employed. Tempering in the range of 1,000° to 1,100° F provided good fracture toughness with slight loss in strength properties that would be expected at higher temperatures. The results are compared with burst tests conducted on Shillelagh motor cases made from the 0.040-in.-thick D6AC steel. Author

N64-18260 American Brake Shoe Co., Mahwah, N.J.
DEVELOPMENT OF HIGH INTEGRITY CLOSE TOLERANCE HIGH STRENGTH AIRCRAFT QUALITY STEEL CASTING Technical Documentary Report, May 1961-May 1963
John B. Dabney and Hugo R. Larson Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 97 p refs
(Contract AF 33(616)-8004)
(ASD-TDR-63-708; AD-434383)

A program to improve the mechanical properties of cast 5% chromium steel has been carried out. Vacuum degassing of air-melted material of a composition based on that of wrought H-11 hot work die steel did not exhibit any significant benefits. Although possessing excellent tensile properties in cast 1-in. sections at the 200,000-psi yield-strength level, material of this standard composition had low-notched tensile strength and erratic and generally poor charpy impact toughness. The lack of toughness is the result of coarse bainite in the microstructure. A modified 5% chromium steel containing no vanadium and 2.4% molybdenum had good tensile properties and excellent toughness in cast 1-in. sections. Investigation of the properties of cast 18% nickel maraging steel revealed that this material has high toughness and ductility in cast 1-in. sections. Cast sections of maraging steel of 2 in. and greater exhibited a defect that seriously impaired tensile properties. Author

N64-18293* Battelle Memorial Inst., Columbus, Ohio
ENGINEERING PROPERTIES OF POTASSIUM Final Report
A. W. Lemmon, Jr., H. W. Deem, E. A. Eldridge, E. H. Hall, J. Matolich, Jr. et al 31 Dec. 1963 83 p refs
(NASA Contract NAS5-584)
(NASA CR-54017; BATT-4673-FINAL) OTS: $8.10 ph

Many of the thermodynamic and transport properties of potassium, both liquid and vapor, have been measured for temperatures to 2,100° F. Experimental values for vapor pressure; specific heat, thermal conductivity, and viscosity of liquid; and P-V-T characteristics have been obtained. Experimental techniques for the direct measurement of the specific heat of potassium vapor and for the measurement of its viscosity and thermal conductivity have also been explored and developed. The latent heat of vaporization, and the enthalpy, entropy, and specific heat of potassium vapor have been computed from some of the data obtained. Author

N64-18294* Battelle Memorial Inst., Columbus, Ohio
THE SPECIFIC HEAT, THERMAL CONDUCTIVITY, AND VISCOSITY OF LIQUID CESIUM
A. W. Lemmon, Jr., H. W. Deem, E. A. Eldridge, E. H. Hall, J. Matolich, Jr., and J. F. Walling 29 Feb. 1964 39 p refs
(NASA Contract NAS5-584)
(NASA CR-54018; BATT-4673-T7) OTS: $3.60 ph

The specific heat, thermal conductivity, and viscosity of liquid cesium have been determined at temperatures to 2,100° F. Specific heats were determined by measurements in a Bunsen ice calorimeter of the heat content of a cesium sample encapsulated in Nb-1Zr alloy. Thermal conductivities and electrical resistivities of cesium were measured in a steady-state, longitudinal-heat-flow apparatus. Corrections for the conduction of the container required that the thermal conductivities and electrical resistivities of the Nb-1Zr alloy also be measured. By finding the decrement of an oscillating cylinder partially filled with cesium, the desired viscosity values were computed from the theoretical relation. Author

N64-18296 Joint Publications Research Service, Washington, D.C.
CONFERENCE ON STRENGTH OF MATERIALS AND STRUCTURAL ELEMENTS AT HIGH TEMPERATURES
Yu. O. Kashtalyan 13 Apr. 1964 12 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1964 p 141–143
(JPRS-24166; OTS-64-31067) OTS: $0.50

The majority of the reports presented at the conference deal with the problem of short and long durability, creep, and

thermal fatigue of refractory materials and of heat-resistant materials, such as cermets and alloys, at high temperatures. Also discussed are the strength and durability of gas-turbine parts under high-temperature conditions. The development of new methods and equipment was reported; this development facilitated investigations of the physical and mechanical properties of materials at high temperatures. I.v.L.

N64-18320 Argonne National Lab., Ill. Metallurgy Div.
CORROSION EXPERIENCE WITH ALUMINUM POWDER PRODUCTS
J. E. Draley, W. E. Ruther, and S. Greenberg Nov. 1963 30 p refs
(Contract W-31-109-ENG-38)
(ANL-6785) OTS: $0.75

Extrusions of aluminum alloy powder products were evaluated for corrosion resistance to high-temperature (260° to 350° C) water. Several types of impact-extruded tubing were tested. The stronger tubing (M655) failed very rapidly. The weaker tubing suffered extensive localized surface attack and penetration of the corrosion attack along the extrusion direction after prolonged (~3 mo) exposure to 290° C water. Several types of tubing extruded through a bridge die were tested. All tubes failed on prolonged (~8 mo) corrosion in 290° C water at the longitudinal bond lines. Directly extruded tubing also failed on extended exposure to 290° C water. Many experimental rod extrusions exhibited corrosion resistance to static 290° C water equivalent to that of wrought alloys. The Trefimetaux specimens were also tested in rapidly flowing water at 315° C. Author

N64-18371 ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF THROAT MATERIALS IN THE HOTSHOT TUNNEL F
H. K. Smithson Arnold Eng. Develop. Center, Mar. 1964 18 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-56; AD-433670)

Several experimental throat materials were tested in the 100-in. Tunnel F. Results of these tests showed that tungsten and copper-filled tungsten were more satisfactory than other materials investigated. Author

N64-18401 Joint Publications Research Service, Washington, D.C.
SEMINAR ON SURFACE DIFFUSION SATURATION OF METALS AND COATINGS
O. P. Epik 13 Apr. 1964 11 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), no. 1, 1964 p 138–140
(JPRS-24165; OTS-64-31066) OTS: $0.50

Brief summaries are given of the papers presented at the seminar. The papers deal, in general, with: (1) diffusion saturation of metals; and (2) diffusion of coatings made of refractory compounds on metal and nonmetal materials. P.V.E.

N64-18458 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
FLUXES AND THEIR USE IN SOLDERING ALUMINUM. A LITERATURE SEARCH
James M. Jacobs, comp. Feb. 1964 27 p 452 refs
(TID-3577) OTS: $0.50

Citations to the report and published literature on the fluxes used in aluminum soldering and the techniques applied, when soldering aluminum with the aid of fluxes, are presented. Personal author, report number, and patent indexes are included. Author

N64-18513* Aerojet-General Corp., Downey, Calif. Ordnance Div.
METALLURGICAL EFFECTS OF EXPLOSIVE STRAIN RATES ON METAL ALLOYS Annual Summary Report, 27 Jul. 1962-26 Jul. 1963
J. F. Wilkin, E. K. Henriksen, and I. Lieberman 26 Jul. 1963 122 p
(NASA Contract NAS8-2416)
(NASA CR-53640; Rept. 0513-01(02)FP) OTS: $10.10 ph

This program investigated the effects of explosive strain rates on the mechanical and physical properties of the following metal alloys and weldments: 2219-T37 Aluminum Alloy, 2219-T87 Aluminum Alloy, 5A1-2.5Sn Titanium Alloy (Annealed), and René 41 Nickel Alloy. Mechanical properties generally show no detrimental effects in the materials investigated when subjected to explosive strain rates. Residual stresses in 2219-T87 aluminum, formed hydraulically, approach values that may be considered hazardous, as opposed to stresses present in explosive forming that are at considerably lower levels. Changes in metallurgical structure resulting from explosive straining are not evident, and differences in structure as a result of strain rate within the range investigated cannot be determined microscopically. X-ray diffraction studies, however, may be successful in detecting structural changes resulting from strain-rate application for specific materials only. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-17846 Princeton U., N.J.
AN INVESTIGATION OF METHODS OF USING A GRAPHITE RESISTANCE HEATER WITH AIR [Final Report]
I. E. Vas and S. M. Bogdonoff Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Oct. 1963 20 p refs
(Contract AF 33(657)-8818)
(ARL-63-188; AD-432499) OTS: $0.50

An investigation of the possibility of using a graphite heater as a basis for an air heating device has shown that the three most promising materials to coat the graphite, boron nitride, hafnium carbide, and zirconium carbide, were not satisfactory. Other methods for heating air are suggested. Author

N64-17959 National Research Corp., Cambridge, Mass.
THEORETICAL AND EXPERIMENTAL STUDY TO DETERMINE OUTGASSING CHARACTERISTICS OF VARIOUS MATERIALS
M. P. Schrank, F. C. Benner, and D. K. Das Arnold Eng. Develop. Center, Mar. 1964 122 p refs
(Contract AF 40(600)-999)
(AEDC-TDR-64-53; AD-433484)

The report presents the results of experimental studies in outgassing characteristics of materials including both total outgassing rates and analysis of constituents. Two types of experiments were performed: (1) outgassing of structural materials using metal bell jars made of the test material, and (2) outgassing of small test samples installed in a glass vacuum system. Extensive outgassing data were obtained on stainless steel 304 ELC and aluminum alloy 5083-0 in the bell jar tests at several temperature increments between 100° C and LN_2 temperature (78° K). It was shown that the aluminum alloy

5083-0 is an adequate material for vacuum chambers where either no bakeout or temperatures only up to +150° to +200° C are applied. Among the ceramics tested, Al-Si-Mag 614 and Mycalex 400 showed excellent properties for construction materials in vacuum chambers. Very low outgassing rates could also be measured on ceramic-coated copper wire. Teflon No. 7 has low outgassing rates when it is preheated by a soft bakeout. Author

N64-17986 Bureau of Mines, Norris, Tenn.
CORROSION RESISTANCE OF DIBORIDES IN THE PSEUDOBINARY SYSTEM TiB_2-CrB_2
Gilbert M. Farrior 1964 25 p refs
(BM-RI-6418)

Tests of resistance to molten metals, to oxidation at elevated temperatures, and to various chemical reagents were made for a series of compositions in the TiB_2-CrB_2 subsystem. There was no noticeable difference in reaction with molten metals of the various compositions in the $(Ti,Cr)B_2$ series. The oxidation tests were (1) a rising-temperature test in which the specimen temperature was increased 4° C per minute to 1,200° C and (2) a constant-temperature test in which the specimen temperature was held constant at 1,000° C. Compositions near $Ti_{0.6}Cr_{0.4}B_2$ had the best oxidation resistance. The chromium-rich alloys showed marked superiority to the titanium-rich alloys in resistance to corrosion by the chemical agents investigated. The chemical reagents used were sulfuric, nitric, and hydrochloric acids and sodium hydroxide of different concentrations. Author

N64-18008 Sandia Corp., Albuquerque, N. Mex.
GAMMA-RAY PHOTOCONDUCTIVITY DECAY IN ORGANIC DIELECTRIC MATERIALS
S. E. Harrison Jun. 1963 20 p refs Presented at the Summer Gen. Meeting of the Inst. of Elec. and Electron. Engr., Toronto, Jun. 1963
(SCR-671)

From experimental data it has been determined that gamma-ray photoconductivity decay in a number of organic dielectric materials can be characterized to good approximation by

$$\frac{\sigma(t)}{\sigma'_0} = \sum_{i=1}^{n} K_i e^{-\nu\tau_i}$$

where $\sigma(t)$ is the conductivity as a function of time during the decay, σ'_0 the conductivity at time zero immediately prior to removal of the gamma-ray intensity, n the number of decay time constants in the decay, τ_i the magnitude of the i^{th} decay time constant, and k_i the weighting factor associated with the i^{th} decay time constant. Experimental values for n, τ_i, k_i, and σ'_0 were measured for Teflon, polyethylene, polyvinylchloride, polystyrene, Kel-F, and nylon. Author

N64-18020 Eastman Kodak Co., Rochester, N.Y. Apparatus Optical Div.
LONG WAVELENGTH INFRARED DOMES Final Report, Jul. 1962-Oct. 1963
Leroy S. Ladd, Richard Clark, and Donald Roy Mar. 1964 51 p refs
(Contract AF 33(657)-8712)
(AL-TDR-64-9; AD-433950)

Zinc selenide has been developed into a useful infrared optical material for the 1- to 20-micron range. Hot-pressing was used to fabricate 6-in.-diam flats and 4-in.-diam domes. Procedures are described for annealing the material, which is highly strained when it is hot pressed. A method is described for bonding hot-pressed sections into larger mosaics by direct fusion or welding. A barium fluoride low-reflection coating was the best of several systems investigated. Optical working and polishing methods are presented. Physical and chemical property measurements are reported. Author

N64-18024 Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
ANALYSIS OF ALUMINA CRUCIBLE FAILURES IN THE PRESENCE OF NICKEL-COPPER-IRON ALLOYS Technical Documentary Report, Apr.-Sep. 1963
Robert Patton Feb. 1964 34 p refs
(RTD-TDR-63-4159; AD-432383)

An unusual alumina crucible failure is analyzed, and a mechanism is postulated to account for the inordinately severe corrosion occurring near a localized region of high stress. The binary phase diagram of iron and oxygen is reviewed along with the pseudobinary of FeO-Al_2O_3 and the ternary phase relationship of Fe-Al-O at 1,350° C. These data, along with other information, are used to suggest a reaction similar to stress corrosion in metals. Author

N64-18026 Union Carbide Corp., Lawrenceburg, Tenn. National Carbon Div.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXIII: A METHOD FOR DETERMINING YOUNG'S MODULUS OF GRAPHITE AT ELEVATED TEMPERATURES Technical Report, Nov. 1, 1961-May 1, 1962
S. O. Johnson and R. B. Dull Wright-Patterson AFB, Ohio. AF Materials Lab., Feb. 1964 22 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. 23; AD-433488)

A vibrational or "sonic" method has been developed for determining the elastic modulus of graphite to temperatures of 3,000° C. Theory is summarized, and working equations are provided. Limitations and assumptions made are discussed with reference to other methods of measurement. Apparatus and procedure are described in detail. Some typical results are included to demonstrate feasibility of the method. Author

N64-18098* General Electric Co., Philadelphia, Pa. Missile and Space Div.
RF TRANSPARENT, ENERGY ABSORBING, STRUCTURAL ELEMENTS, PHASE I Final Report
W. M. Meyers and H. G. Lorsch 16 Mar. 1964 133 p refs Work performed for JPL
(NASA Contract NAS7-100; JPL Contract 950564)
(NASA CR-53479; Doc. 64SD565) OTS: $10.50 ph

The design objective was to develop a material that has a specific energy absorption capability of at least 10,000 ft-lb/lb and is transparent to radiofrequency transmission and that can be designed to exhibit different specific energies by variation of the particular controlling parameters in the element. Details of the design, fabrication, testing, and performance of the system are included. Author

N64-18185 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
PROPERTIES OF COATED REFRACTORY METALS
W. A. Gibeaut and E. S. Bartlett 10 Jan. 1964 98 p refs
(Contract AF 33(615)-1121)
(DMIC-195; AD-433782)

Programs to provide comparative evaluations of coatings on columbium and molybdenum alloys have pointed up some of the relative merits and deficiencies of the various coatings. Properties that have been studied and evaluated in recent investigations have included the following: (1) oxidation lives at

various temperatures and pressures; (2) degradation in low-temperature ductility of substrates by coatings or coating processes; (3) degradation of mechanical properties by oxidation exposure (thermal stability); (4) effects of strain at low and high temperatures on protectiveness of coatings; (5) stress rupture and creep data of coated systems; (6) fatigue properties of coated systems; and (7) emittance of coatings. Author

N64-18186 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
NEW CORROSION INHIBITORS FOR ANTIFREEZES
Charles B. Jordan 16 Jan. 1964 17 p refs
(CCL-155; AD-433661)

The object of this study was to conduct a preliminary investigation of newly developed corrosion inhibitors and inhibitor combinations for use in automotive coolants. Bench corrosion tests were conducted on the following inhibitors in water and ethylene glycol/water solutions: sodium tetraborate/propylene glycol condensate, the double condensate of sodium tetraborate with propylene glycol and butynediol, and Specification O-I-490 inhibitor modified by adding disodium phosphate and increasing the mercaptobenzothiazole content. Author

N64-18193 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
THE DEVELOPMENT OF AN IMPROVED COOLING SYSTEM CORROSION INHIBITOR
James H. Conley 10 Feb. 1964 26 p refs
(CCL-156; AD-433829)

The object of this study was to develop an improved inhibitor combination for use in water and ethylene glycol antifreeze mixtures. Bench corrosion tests were used for initial screening. The more promising coolant and inhibitor combinations were then evaluated in simulated service tests. One combination was chosen for vehicle field tests. An improved inhibitor was found that consists of borax, mercaptobenzothiazole, and disodium phosphate. Author

N64-18264 ARO, Inc., Arnold Air Force Station, Tenn.
TABLES OF THERMODYNAMIC PROPERTIES OF ARGON FROM 100 TO 3000°K
Wanda J. Little Arnold Eng. Develop. Center, Apr. 1964 129 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-68; AD-434368)

Tables of the thermodynamic properties of argon are presented for the temperature range of 100° to 3,000° K. In the first table, temperature and pressure are the independent variables, with the pressure range extending from 1 to 5,000 atm. In the second table, temperature and density are the independent variables, with a density range extending from 10^{-7} to 630 amagats. The additional tabulated properties are the compressiblity factor Z and the dimensionless functions E/RT, H/RT, and S/R. The sources of data and the tables are discussed. Author

N64-18265 Aerojet-General Corp., Sacramento, Calif.
DEVELOPMENT OF HIGH-STRENGTH IMPREGNATED ROVING FOR FILAMENT WINDING Bimonthly Progress Report No. 5, 11 Dec. 1963–10 Feb. 1964
H. Bernstein et al 20 Mar. 1964 18 p
(Contract NOw-63-0627-c FBM)
(Rept. 0627-V-5; AD-434280)

The object of this program is to improve uniformity and strength utilization in preimpregnated roving for filament-wound rocket chambers. The work is being conducted in support of the Polaris program. An evaluation was made of dry glass materials, and progress in the development of linearized preimpregnated roving is discussed. R.T.K.

N64-18305* Rensselaer Polytechnic Inst., Troy, N.Y.
THE INFLUENCE OF THERMAL TREATMENTS UPON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF ALUMINUM-ALUMINUM OXIDE ALLOYS
J. A. Dromsky (Ph.D. Thesis) and F. V. Lenel 1963 29 p refs
(NASA Grant NsG-38-60)
(NASA CR-53558) OTS: $2.60 ph

Compacts from atomized and flake aluminum powders were sintered at temperatures just below the melting point of aluminum in a vacuum of 10^{-4} torr for several hours and were then hot extruded. Extrusions of compacts so treated are stable at temperatures up to the melting point of aluminum and do not form blisters and internal defects typical of extrusions from untreated powder. Electron micrographs of extrusions from unsintered compacts show long parallel oriented platelets typical of the hydrated oxide skins on the original powder particles, whereas the oxide particles in extrusions from sintered compacts are broken up. The strength of extrusions from treated powder is somewhat lower, but their ductility is considerably improved over that of extrusions from untreated powder. Author

N64-18368 Naval Research Lab., Washington, D.C.
HYDROPHOBIC AND OLEOPHOBIC FLUOROPOLYMER COATINGS OF EXTREMELY LOW SURFACE ENERGY – PROPERTIES AND APPLICATIONS
Marianne K. Bernett and W. A. Zisman 14 Feb. 1964 12 p refs
(NRL-6039; AD-434213)

A comparison of the critical surface tension of wetting γ_c of new, but commercially available, polymeric solids has revealed that a group of polyfluoroesters had the lowest values of γ_c of any plastics or other solids yet reported. In order to assess their possible utility in certain new potential naval applications, experimental studies were made on the effect of high humidity and immersion in organic liquids on thin coatings of the two fluorinated polyesters. No changes in coating adhesion to the underlying resin or metal surfaces were found after such exposures, nor were the wettability or other physical properties of the coatings significantly affected. Prevention of spreading by fine instrument oils on surfaces of substances such as stainless steel, sapphire, and Pyrex glass was also investigated by applying the coatings as barriers in the form of narrow circular bands, placing the spreading-oil drops in the uncoated center, and exposing the specimens to the atmosphere at ambient temperatures or cycles between +50° and −20° C. Author

N64-18381 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
GAS ADSORPTION OF AN ORGANIC SURFACE: HMX
Phillip Rechlin Mar. 1964 24 p refs
(PA-TR-3092; AD-434285)

Attempts to measure adsorption on the surface of HMX using N_2 and CO with the continuous flow modification of the BET (Brunauer–Emmett–Teller) gas adsorption technique were unsuccessful. Either (1) no adsorption takes place on the HMX under these conditions, (2) the gas adsorption technique is not sensitive enough to be used to measure the area of a surface as inactive as that of HMX, or (3) the adsorption that actually takes place is masked by effects due to heretofore unobserved polymorphic changes in the crystalline structure of the material. Heating the HMX crystals to about 185° C, well below the melting point, does not activate the surface, but results rather in small amounts of decomposition. Author

N64-18384 Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
ALUMINUM OXIDE Data Sheets
John T. Milek Mar. 1964 188 p refs
(Contract AF 33(615)-1235)
(DS-136; AD-434173)

A compilation of the electrical properties of a wide range (80% to 100%) aluminum oxide ceramic composition is presented herein. Included are sapphire, sintered single crystal and polycrystalline material. Detailed electrical properties for the individual alumina material data sheet include dielectric constant, dielectric strength, dissipation factor, electrical conductivity, electrical resistivity, loss factor, and T.E. value (the temperature change that will change the resistivity by one decade). Each property is compiled over the widest possible range of temperatures and frequencies from references obtained in a thorough literature search. The crystal structure, applications, and phase diagrams are briefly rev ewed. Author

N64-18507* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THERMODYNAMIC PROPERTIES AND MOLLIER CHART FOR HYDROGEN FROM 300°K TO 20,000°K
Robert F. Kubin and Leroy L. Presley Washington, NASA, 1964 69 p refs
(NASA SP-3002) OTS: $1.75

The thermodynamic properties of hydrogen have been calculated over a temperature range of 300° to 20,000° K for pressures ranging from 10^{-4} to 10^{3} atmospheres. The calculated properties include energy, enthalpy, entropy, specific heats, equilibrium constants for dissociation and ionization, chemical composition, density, compressibility, and speed of sound. In the analysis, hydrogen is treated as a reacting gas mixture in which each component obeys the perfect gas equation-of-state. Results are presented in tabular form and in the form of a Mollier diagram. They are found to agree within ±5 percent of the results of more rigorous calculations and are thus considered to be suitable for engineering purposes. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-17847 Uppsala U. (Sweden) Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory
THE FIRST ORDER DENSITY MATRIX FOR A SPIN-PROJECTED SINGLE DETERMINANT. II: NATURAL EXPANSION
John E. Harriman 15 Aug. 1963 30 p refs
(Contract AF 61(052)-351)
(Tech. Note 104; ARL-63-230; AD-424772)

The first-order density matrix is obtained for the state corresponding to a spin projection of general, different orbitals for different-spin single-determinant functions. Explicit expressions are given for the natural orbitals and occupation numbers in terms of parameters characteristic of the unprojected state. The spin density and the charge density matrices are found to have the same natural orbitals in the projected state as in the unprojected state. A number of special and limiting cases are considered, including that of slightly different orbitals for different spins. Author

N64-17848 Ohio State U., Columbus
AN INVESTIGATION OF CONDITIONS INFLUENCING THE DEVELOPMENT OF PERCEPTUAL SETS
Delos D. Wickens and Armand N. Chambers Wright-Patterson AFB, Ohio, Behavioral Sci. Lab., Oct. 1963 32 p refs
(Contract AF 33(616)-7778)
(AMRL-TDR-63-98; AD-432498)

The experiment was designed to measure transfer effects in a perceptual motor task when (1) the critical stimulus dimension that was irrelevant in the first task became relevant for performance on the second task and (2) where the same stimulus dimension was relevant for both tasks but responses were interchanged. Author

N64-17852 Systems Development Corp., Santa Monica, Calif.
SEQUENCES IN CONTEXT FREE LANGUAGES Scientific Report No. 6
Seymour Ginsburg, Thomas N. Hibbard, and Joseph S. Ullian 13 Nov. 1963 33 p refs
(Contract AF 19(628)-485)
(SDC-TM-738/001/01; AFCRL-63-579; AD-429895)

A number of facts about sequences in languages (context free languages) are established. It is shown that the problem of whether a language contains at least one sequence is unsolvable, and of whether a language contains at least one ultimately periodic sequence is unsolvable. The problem of whether a language contains a given sequence is unsolvable, but of whether a language contains a given ultimately periodic sequence is solvable. It is proved that there exists a language that contains a sequence but no ultimately periodic sequence. More strongly, there exists a language that contains a sequence but no recursive sequence. Author

N64-17879* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
PROCESS ANALYSIS AND SYNTHESIS
M. V. Cerrillo, H. J. Zimmermann, J. S. Mac Donald, and Rita K. Toebes *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 187-191 ref (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

The aim of this research has been to seek theoretical descriptions of some of the subjective aspects of communication. The theory of groups and the generalized concepts of symmetry are being used in an attempt to describe certain aspects of perception and recognition. It is assumed that the structure of such processes can be described by a set of elements and by a set of rules that operate on these elements. The processes now being investigated include perception of brightness, color, depth, and form. Handwriting is also being studied by methods aimed at extending the work of Dernier van der Gon. A rudimentary simulator of the handwriting process has been constructed, and an improved version is being completed. Work is also being done on the subjective structure of music. Mathematical work includes the investigation of the complete subgroup structure of the symmetric group of degree five, the theory of uniformization of curves, and the theory of moments in connection with the algebraic domain. Author

N64-17881* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
ARTIFICIAL INTELLIGENCE

M. L. Minsky, H. Putnam, A. L. Samuel, C. E. Shannon, S. Papert et al. *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 209–210 refs (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

Ways of using machines to solve problems that are usually considered to require intelligence were investigated. A major part of the effort was directed toward the development of ways of communicating more effectively with a computer. This work has two aspects—development of a system for instructing the computer in declarative, as well as imperative sentences, called the advice-taker; and development of a programing language called LISP for manipulating symbolic expressions that will be used for programing the advice-taker system and also will be of more general use. R.T.K.

N64-17888* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
COMPUTER RESEARCH
J. B. Dennis, N. Kerllenevich, and R. J. Levy *In its* Quarterly Progress Rept. No. 72 [for Period Ending Nov. 30, 1963] 15 Jan. 1964 p 301–302 refs (See N64-17876 10-01)
(NASA Grant NsG-496; NSF Grant G-16526; NIH Grant MH-04737-03)

A multiuser computation facility built around the PDP-1 computer has been placed in operation. At present, the installation permits three persons to encode, test, and operate programs from individual typewriter stations using symbolic languages. A flexible arrangement for the operation of external equipment by time-sharing programs has been included in the system. One application of this feature is the guidance of a high-gain antenna in celestial coordinates for experiments of the Radio Astronomy Group. The tracking computation may proceed in parallel with use of the machine by the three on-line users. Author

N64-17922 Wisconsin U., Madison. Mathematics Research Center
MATRICES SIMILAR ON A ZARISKI-OPEN SET
Jack Ohm and Hans Schneider. Feb. 1964 20 p refs
(Contract DA-11-022-ORD-2059; Contract Nonr-1202(20); NSF Grant GP-2273)
(MRC-TSR-449; AD-433944)

Theorems due to Wasow and Ostrowski concerning the similarity of matrices whose elements are holomorphic functions are generalized to the case of matrices whose elements lie in an arbitrary commutative integral domain. The chief tool for this generalization is the Zariski topology. The integral domain consisting of certain functions on a topological space is an interesting special case. Author

N64-17957 Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
A STATISTICAL METHOD OF REDUCING RANDOM ERRORS IN DATA Technical Documentary Report, Jan.–May 1963
Pierce M. Williamson. Oct. 1963 12 p
(RTD-TDR-63-4020; AD-423435)

A method of modifying observed or calculated data to reduce random errors has been devised. It is based on applying standard statistical calculations to sets of first-order differences, the sets varying from each other by the length of intervals used. It is suitable for unrepeatable observations, rather than for laboratory experimental results, and for timewise noncyclical numerical indexes. Author

N64-17969 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THEORY AND METHODS OF MATHEMATICAL SIMULATION
B. Ya. Kogan and A. V. Shileiko. 3 Feb. 1964 6 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 1, 1963 p 121–122
(RSIC-125; AD-433289)

A general report on a conference concerning theories and methods of adapting computers for various operations, held in Moscow from 30 October to 3 November 1962, is presented. Among the topics discussed were: the use of analog and digital computers for optimum control and arrangement of appropriate systems; the application of computers to self-adjusting control systems; digital simulation, including analysis and arrangement of algorithms; assembly of digital units and practical assembly problems of digital differential analyzers and separate digital units; new methods of assembling analog feedback elements and their control; and general questions dealing with solutions of the problems of analog computers and evaluation of their errors. New ideas expressed at the conference are briefly sketched, and the conclusion is reached that the computing potentialities of digital differential analyzers are very limited, making them barely useful in a system of automatic control. M.P.G.

N64-17974 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS IN OPTIMUM CONTROL THEORY
Yu. V. Yegorov. 7 Apr. 1964 25 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 3, no. 5, Sep.–Oct. 1963 p 887–904
(JPRS-24072; OTS-64-31009) OTS: $0.75

Some questions concerning the theory of controlled thermal processes, namely, questions connected with selection of a control that is optimum in any sense, are discussed. The processes of heat distribution in a rod, when the temperature of the surrounding medium can be regulated within certain limits, are examined. The conditions for optimum control are defined, and methods for determining it numerically are proposed. R.T.K.

N64-17989* Measurement Analysis Corp., Los Angeles, Calif.
FREQUENCY RESPONSE FUNCTIONS AND COHERENCE FUNCTIONS FOR MULTIPLE INPUT LINEAR SYSTEMS
Loren D. Enochson. Washington, NASA, Apr. 1964 80 p refs
(NASA Contract NAS5-4590)
(NASA CR-32) OTS: $2.00

Multiple input linear system frequency response functions and associated applications of coherence functions are considered. Single input–single output linear systems are described, and pertinent definitions and formulas are presented. These initial sections serve as an introduction to the multiple input linear system material. The coherence function for the single input–single output case is defined, and the behavior of this function is found for situations where noise is occurring in either, or both, the input and output measuring devices. This presentation demonstrates that the coherence function is a useful parameter in determining confidence limits for measurements of the gain factor and the phase angle of a linear system frequency response function. Author

N64-18014 RAND Corp., Santa Monica, Calif.
ANOTHER COMPUTATIONAL APPROACH TO A MATHEMATICAL MODEL OF TURBULENCE
S. P. Azen, R. Bellman, and J. M. Richardson Jan. 1964 14 p refs
(ARPA Order 189-61; Contract ARPA-SD-79)
(RM-3918-ARPA)

The nonlinearity of the equations of turbulence necessitates the study of approximation techniques, such as "model equations," which exhibit many of the characteristics of the realistic equations. Computational methods to the solution of the model equation of Burgers are investigated. The application of a difference algorithm is studied. Numerical results obtained from a FORTRAN program are given. Author

N64-18016 Wisconsin U., Madison
MULTIVARIATE SPECTRAL THEORY Technical Summary Report
F. V. Atkinson Jan. 1964 54 p refs
(Contract DA-11-022-ORD-2059)
(MRC-431; AD-433943)

A series of papers is to deal with simultaneous eigenvalue problems concerning k equations, of differential or other type, with supplementary homogeneous conditions, involving k disposable parameters. The present part is devoted to the finite-dimensional analog, in which there are k simultaneous equations in k vector spaces, connected by the presence in each of the same k parameters. Author

N64-18017 Wisconsin U., Madison
NUMERICAL PROCEDURES FOR INTERPOLATION BY SPLINE FUNCTIONS Technical Summary Report
T. N. E. Greville Jan. 1964 31 p refs
(Contract DA-11-022-ORD-2059)
(MRC-450; AD-433945)

This report describes numerical procedures for interpolation by means of spline functions, that is, functions defined by piecewise polynomial arcs smoothly joined in such a way that derivatives are continuous everywhere up to an order one less than the degree of polynomials used. This is facilitated by Schoenberg and Whitney's unique representation of an arbitrary spline function as the sum of a polynomial and a linear combination of "elementary spline functions" of particularly simple form. DeBoor has shown that the smoothest function in C^k that can be fitted to n given data points is a spline function of degree $2k-1$. A method for numerical determination of the DeBoor interpolation function is described, and an alternative representation of this function in the case of equally spaced data points is given. Author

N64-18018 Wisconsin U., Madison
NUMERICAL EVALUATION OF INTEGRALS AND SOLUTIONS OF INTEGRAL EQUATIONS Technical Summary Report
L. B. Rall Feb. 1964 24 p refs
(Contract DA-11-022-ORD-2059)
(MRC-461; AD-433947)

A method for numerical integration, based on the definition of the Riemann integral, gives approximations for which rigorous error bounds may be obtained automatically as a result of the computations. The same procedure is extended to integral equations, and it is shown that under certain conditions, the convergence of the approximating procedure guarantees the existence of a solution of the original problem, as well as giving approximate solutions with known error bounds. Applications of this method to linear and nonlinear integral equations are given. Author

N64-18022 Stanford Research Inst., Menlo Park, Calif.
CELLULAR LINEAR-INPUT LOGIC Final Report
Robert C. Minnick and Robert A. Short Feb. 1964 268 p refs
(Contract AF 19(628)-498)
(AFCRL-64-6; AD-433802)

A cellular array is some geometrical arrangement of interconnected cells, where each cell has some logical and storage property. A number of different cellular arrays are proposed and studied in this report. These arrays fall into two structural classes—trees and rectangles. Some of the basic definitions are introduced. Some of the more important potential applications of cellular arrays are considered, such as arrays for the production of combinational digital logic; arrays of majority gates, in terms of trees and rectangles; adder arrays; cutpoint arrays; arrays that have storage; and a class of one-dimensional arrays in which it is possible to transmit a stream of data asynchronously. The combinational cutpoint cell is augmented so that it can form a flip-flop, as well as various logical functions. A cell is developed with which the associative memory operations of arithmetic comparison, as well as direct and inverted inclusion, can be obtained when it is interconnected in an array. Author

N64-18030 Stanford Research Inst., Menlo Park, Calif.
THE PERCEPTRON CORRECTION PROCEDURE IN NONSEPARABLE SITUATIONS
Bradley Efron Griffiss AFB, N.Y., Inform. Process. Branch, Feb. 1964 19 p refs
(Contract AF 30(602)-2943)
(RADC-TDR-63-533; AD-433144)

The behavior of the standard Perceptron correction procedure when the underlying patterns are nonseparable is discussed. It is shown that in this case the magnitude of the succeeding weight vectors remains bounded. Moreover, if the magnitudes approach a limit, this limit is actually attained, and the ensuing behavior is particularly simple. A converse to the usual Perceptron convergence theorem is presented.
Author

N64-18035 Wisconsin U., Madison Mathematics Research Center
LATTICE-ORDERED SEMIGROUPS, GRAPHS AND AUTOMATA Technical Summary Report
Michael Yoeli Jan. 1964 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-451; AD-433946)

A W-semigroup is defined as a lattic-ordered semigroup with zero, the lattice of which is complete and in which multiplication is completely distributive over joins. This paper discusses W-nets, i.e., finite directed graphs the edges of which are labeled by elements of a W-semigroup. It unifies and extends various results concerning switching nets, communication nets, edge sequences in finite graphs, finite-state languages, nondeterministic automata, and derivatives (quotients) of regular expressions. Author

N64-18050 Johns Hopkins U., Baltimore, Md.
Final Report [FUNCTIONAL COHOMOLOGY OPERATIONS]
Jean-Pierre Meyer Sep. 1963 3 p
(Contract DA-31-124-ARO(D)-28)
(AROD-2799-5; AD-420248)

Progress report includes: (1) An axiomatic theory of functional cohomology operations was developed that parallels and generalizes Adam's theory of secondary operations. A relation in the cohomology of a space Z is an identity of the form $\sum_{ij} \alpha_{ij} \cup \theta_{ij}(\beta_j) = 0$, where α_{ij}, β_j are cohomology classes of Z and θ_{ij} are primary cohomology operations. Such a relation

gives rise to functional cohomology operations of the following kind: for every map, $f: X \to Z$ such that $f^*(\delta_j) = 0$, there is a defined subset $\Phi(f)$ of $H^*(X)$. Using cochain formulas to define $\Phi(f)$, properties of this set were studied. (2) It is indicated that all the well-known properties of cohomology operations arise out of corresponding properties of cochain operations. (3) It was proved, using the theory of Hirsch, that, in a certain stable range, every element in the cohomology of the total space of a fibration $p: E \to B$ lies in a set of $\Phi(p)$ arising out of a unique relation in B. If the fibration is principal and the generators of the fiber are universally transgressive, then the relation giving rise to an element ξ in E can be read from $\mu^*(\xi)$, where $\mu: F \times E \to E$ is the operation of the fiber. These results have important applications to the study of Moore–Postnikov systems of fibrations. I.v.L.

N64-18051 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group

METHODS FOR THE SOLUTION OF VARIATIONAL PROBLEMS ON THE BASIS OF THE SUFFICIENT CONDITIONS FOR THE ABSOLUTE MINIMUM. PART I

V. F. Krotov Mar. 1963 25 p refs Transl. into ENGLISH from Avtomatika i Telemekhanika, v. 23, no. 12, Dec. 1962 p 1571-1583
(MH-Transl 427)

Sufficient conditions of optimality of systems described by a finite number of common differential equations are derived. On the basis of these conditions, a single formalism for solution of variational problems for such systems is constructed, and, within its boundaries, different methods are considered that permit the solution of the variational problems completely. Author

N64-18057 Wisconsin U., Madison. Mathematics Research Center

ON THE TOPOLOGICAL STRUCTURE OF SOME ORDERED FAMILIES OF DISTRIBUTIONS

J. Pfanzagl Nov. 1963 27 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-424; AD-431097)

Three different kinds of order relations, of increasing stringency, are considered: order (1)—$P_1 < P_2$, if $F_2(t) \leq F_1(t)$ for all t; order (2)—$P_1 < P_2$ if both order (2'), $F_2(t)/F_1(t)$, and order (2''), $(1 - F_2(t))/(1 - F_1(t))$, are nondecreasing functions of t; and order (3)—$P_1 < P_2$, if the relative density of P_2 with respect to P_1 is a nondecreasing function of t. This paper investigates the consequences of the order relation on the structure of the family. It is shown that a nondegenerate family of distributions (i.e., a family containing at most a countable number of isolated degenerate distribution) is dominated, if it is of order (2). Author

N64-18075 Stanford U., Calif. Inst. for Mathematical Studies in the Social Sciences

ON THE GENERALIZED INVERSE OF AN INCIDENCE MATRIX

Yuji Ijiri 31 Jan. 1964 15 p refs
(Contract Nonr-225(50))
(Tech. Rept. 127; AD-433626)

An incidence matrix has exactly two nonzero entries that are 1.0 and −1.0 in each column of the matrix and has no zero rows. Any two rows of an incidence matrix are said to be directly connected with each other if there is a column that has nonzero entries in both rows. An incidence matrix is a connected incidence matrix if it has only one connected component. The corresponding directed graph of a connected incidence matrix is defined as a graph whose vertices and arcs have one-to-one correspondence with rows and columns, respectively, of the incidence matrix. The properties of the generalized inverse of an arbitrary incidence matrix are examined, in connection with the properties of the corresponding directed graph. E.W.

N64-18079* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

A FORTRAN PROGRAM FOR ANALYSIS OF SPIN ZERO ELASTIC SCATTERING WITH THE NUCLEAR OPTICAL MODEL

C. C. Giamati, W. Tobocman, and D. V. Renkel Washington, NASA, Apr. 1964 53 p refs
(NASA TN D-2120) OTS: $1.25

A FORTRAN program that can be used to analyze the elastic scattering of spin zero particles from an atomic nucleus is presented. The nucleus is represented by the nuclear optical model in the form of a Saxon–Woods volume potential plus a surface interaction potential whose radial dependence is in the form of the derivative of a Saxon–Woods form factor. There are available four independent parameters of each of the two potentials—V and W, the strengths of the real and imaginary parts of the potential, R, the radius of the potential, and a, the diffuseness parameter. Provision is made for varying these parameters over a chosen grid in the parameter space or for searching for a best fit to experimental cross section data by minimizing the χ^2 deviation as a function of chosen parameters. Author

N64-18093 Joint Publications Research Service, Washington, D.C.

MATHEMATICAL SIMULATION AND ELECTRIC CIRCUITS (Proceedings of Seminar on Mathematical Simulation Methods and Electric Circuit Theories)

6 Apr. 1964 360 p refs Transl. into ENGLISH of the book "Matematicheskoye Modeliroveniye i Elektricheskiye Tsepi (Trudy Seminara po Metodam Matematicheskogo Modelirovaniya i Teorii Elektri-cheskikh Tserey)" Kiev, No. 1, 1963 p 1-247
(JPRS-24041; OTS-64-21989) OTS: $5.00

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N64-18101* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SYNTHESIS OF CONTINUOUS ANALOG DATA FROM DISCRETE SAMPLE DATA VIA A PB250-TRICE LINK

John C. Mc Coy 2 Jan. 1964 24 p

(NASA TM X-51542; MTP-COMP-64-1) OTS: $2.60. ph

A procedure is described for using discrete, widely dispersed measurements of wind velocity to generate continuous curves suitable for use as driving functions in a simulated flight of the Saturn vehicle. The observed wind data consist of zonal and meridional velocities measured daily at kilometer intervals above Cape Canaveral, from ground level to 25 kilometers altitude. The problem is solved by first, on the 7090, fitting the 26 values in each set of measurements with a fifth-order smoothing equation. The 7090 next breaks the smoothing curve into 125 segments of equal width, calculates the slopes of straight lines connecting the endpoints of these segments, and records the slopes on tape in PB250 format. With the PB250 acting as interpreter, the TRICE is then used to integrate the slopes with respect to time (the vehicle is assumed to be in vertical flight at constant velocity). Because of the very large number of integration steps per segment, the staircase output of the TRICE approximates a straight line. After digital to analog conversion, zonal and meridional wind profiles in continuous analog form are recorded on magnetic tape for use as inputs to the GPS computer. Author

N64-18109* California U., Berkeley

AN ON LINE SOLUTION TO SAMPLED-DATA TIME OPTIMAL CONTROL

J. H. Eaton Repr. from J. of Electron. Control, v. 15, no. 4, Oct. 1963 p 333–341 refs

(NASA Grant NsG-354)

The problem considered is that of designing a special purpose computer that is rapid enough to provide an on-line solution to the sampled-data time optimal control problem in which the inputs are subjected to amplitude constraints. The computer is used to simulate a differential equation whose steady-state solution yields the input sequence that will take the sampled system from a given initial state to the reachable (in a given number of sampling periods) state closest to a specified terminal state. The time optimal control problem is solved by increasing the number of sampling periods until the specified terminal state is reachable. Preliminary results with a fourth-order system indicate that computer settling times of a few milliseconds can be obtained. Author

N64-18123 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE SOLUTION OF BOUNDARY LAYER EQUATIONS BY THE DIFFERENCE METHOD

I. Yu. Brailovskaya and L. A. Chudov 16 May 1963 23 p refs Transl. into ENGLISH of the book "Vychislitel'nyye Metody i Programmirovaniye" Moscow, Izdat. Moskov. U., 1962, v. 1 p 167–182

(FTD-TT-63-285/1+2+4; AD-409560)

An implicit difference scheme is presented that permits calculation of an entire boundary layer in a simple, uniform, convenient way for digital computers. The system of boundary-layer equations consists of one first-order equation (continuity equation) and several second-order equations. Each of these equations is quasi-linear (linear with respect to the derivative) relative to its "own" corresponding function. In particular, the methods and results of the numerical solution of the system of equations for a two-dimensional steady-state boundary layer on a plate are discussed. The method used can be applied to the particular case of a homogeneous incompressible fluid and to the general case of a multicomponent compressible gas, taking into account heat transfer and diffusion. P.V.E.

N64-18140 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

TESTS FOR INVERTABILITY AND POSITIVE DEFINITENESS OF MATRICES

Allen Van Gelder Jun. 1963 6 p refs

(RN-157)

Two theorems concerning the properties of a partitioned matrix C having partitions A, B, and either M^T or N^T are proven. The theorems are: Theorem I: Let C be the symmetric matrix $C = \begin{pmatrix} A & M \\ M^T & B \end{pmatrix}$. Then, C is positive definite if and only if A, B, and $B-M^TA^{-1}M$ are positive definite. Theorem II: Let C be the matrix $C = \begin{pmatrix} A & M \\ N^T & B \end{pmatrix}$, and let A^{-1} exist. Then C^{-1} exists if and only if $(B-N^TA^{-1}M)^{-1}$ exists. The foregoing theorems permit some properties of large matrices to be inferred from the properties of smaller ones, but do not aid in computation of the inverse or in reduction to canonical form. E.W.

N64-18155 Aeronautical Research Council (Gt. Brit.)
A DIGITAL COMPUTER PROGRAMME FOR THE CALCULATION OF ANNULAR OR TWO-DIMENSIONAL SUPERSONIC POTENTIAL FLOW IN A DUCT BY THE METHOD OF CHARACTERISTICS
P. G. Street London, HMSO, 1963 38 p refs
(ARC-CP-649) HMSO: 7s

A program has been written for the Ferranti Mercury computer to analyze supersonic potential flow in a duct with uniform inlet conditions. Input data consist of duct coordinates, initial Mach number, and flow angle. The program calculates Mach number and flow angle at the nodal points of the characteristics net. It can be used for axisymmetric or two-dimensional flow, depending on a parameter set in the initial data. Author

N64-18178 RAND Corp., Santa Monica, Calif.
COMPUTATIONAL ASPECTS OF APPROXIMATION THEORY
Barry Boehm Mar. 1964 106 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4051-PR; AD-433175)

The theory of approximation by polynomials and rational functions is of considerable practical significance, due in great part to the efficiency of polynomials and rational functions in representing functions on a high-speed digital computer. This memorandum presents some of the more useful theoretical results and their interrelations, and points out some of the practical consequences. Topics include problems of existence, uniqueness, characterization, and error estimation of best approximations, and algorithms for interpolation and for obtaining best least-squares and Chebyshev approximations. Author

N64-18196 Little (Arthur D.) Inc., Cambridge, Mass.
STUDIES FOR THE DESIGN OF AN ENGLISH COMMAND AND CONTROL LANGUAGE SYSTEM Final Report
Vincent E. Guilliano et al L. G. Hanscom Field, Mass., Decision Sci. Lab., Nov. 1963 182 p refs
(Contract AF 19(628)-256)
(CACL-3; ESD-TDR-63-673; AD-433603)

An associative searching technique has been developed for the automatic storage and retrieval of natural language message information. A user may employ his own vocabulary in formulating a typewritten request, and the technique allows the machine to find relevant information even when there is no direct matching of vocabulary items. Answers are based on the network of associations implicit in the stored message data, and items are outputed in order of decreasing relevance to the question. Author

N64-18231* Sperry Gyroscope Co., Great Neck, N.Y.
A STUDY OF IBM 7094 FORTRAN IV SUBROUTINES
D. Epstein *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 65–71 (See N64-18226 10-01) OTS: $11.00 ph

This document describes the results of an investigation to determine the accuracy of the single- and double-precision numerical subroutines that are standard for the IBM 7094 version of FORTRAN IV. The purpose of the investigation is to estimate the level of confidence to be placed in the subroutines and to find the rms error and maximum error for error analysis purposes. An incidental purpose was to provide experience in using the subroutines. Author

N64-18233* Sperry Gyroscope Co., Great Neck, N.Y.
MATRIX MANIPULATIONS
J. A. Winokur *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 88–98 refs (See N64-18226 10-01) OTS: $11.00 ph

Since a precision of $1:10^9$ is desired throughout the MINIVAR Program, those operations that are susceptible to loss of precision are examined. A method is described whereby a matrix having an order up to 8 × 8 may be inverted through use of an approximation to the true inverse and through an iteration procedure for refining this estimate. The results of the comparison between the SHARE routine inverse and the iterated inverse are presented. R.T.K.

N64-18234* Sperry Gyroscope Co., Great Neck, N.Y.
DERIVATIVES IN TERMS OF CENTRAL DIFFERENCES
E. E. Grinoch *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 99–102 (See N64-18226 10-01) OTS: $11.00 ph

Formulas are considered in terms of the central-difference operator. A central-difference numerical-differentiation formula is derived; the uses of this formula are: (1) as a measure of the precision attainable in computing the elements of the two-body state transition matrix, whether by means of the variational parameters now used in MINIVAR or by some other technique; and (2) as a method for obtaining the elements of the true transition matrix in those instances for which the two-body approximation is inadequate. R.T.K.

N64-18236* Sperry Gyroscope Co., Great Neck, N.Y.
INCORPORATION OF BIAS ERRORS INTO THE ESTIMATIONS PROCEDURE
J. A. Winokur *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 108–116 (See N64-18226 10-01) OTS: $11.00 ph

Bias errors to be included in MINIVAR are discussed. The bias errors are of 19 different types. Among these errors are station-location errors, uncertainty in the knowledge of earth's mass and oblateness terms, and uncertainties in the velocity of light and the astronomical unit. Augmentation of the state transition matrix and the point transformation matrices associated with the variational parameters are discussed. R.T.K.

N64-18237* Sperry Gyroscope Co., Great Neck, N.Y.
PRECISION OF THE OPTIMUM FILTER K
C. I. Smith *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 117–123 (See N64-18226 10-01) OTS: $11.00 ph

In MINIVAR, the state transition matrix is used only to transform the covariance matrix of the state variables from one data point to the next. A program is described whereby the effect of errors in the elements of the state transition matrix on the elements of the Kalman filter K may be computed. R.T.K.

N64-18238* Sperry Gyroscope Co., Great Neck, N.Y.
EXECUTIVE ROUTINE
C. Milner *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 124–125 (See N64-18226 10-01) OTS: $11.00 ph

The alternate executive routine is described as follows: (1) utilization of the history tape; and (2) the library tape procedures. R.T.K.

N64-18246 Defence Research Telecommunications Establishment, Ottawa (Canada) Communications Lab.
THE REQUIREMENTS FOR ON-SITE COMPUTING FACILITIES
O. S. Roscoe *In its* Some Considerations in Satellite Commun. Systems Jan. 1964 5 p ref (See N64-18241 10-08)

The following operations, associated with satellite tracking, that can be performed most efficiently with a digital computer, are discussed: prediction of satellite entry into regions of mutual visibility, acquisition by computer-controlled search, tracking from computed look-angles, smoothing of tracking data, determination of the orbital elements for upgrading, detection and correction of systematic errors, backup to active tracking by providing course extrapolation, prediction and minimization of signal loss due zenith gimbal lock, handover control for continuous communication in multiple satellite systems, and bookkeeping of orbital elements in multiple satellite systems. Also presented is a brief discussion of computer uses in data processing. Some general computer specifications that can be derived from the uses discussed are included. R.T.K.

N64-18269 Wisconsin U., Madison
ON SUMS OF POWERS OF COMPLEX NUMBERS; AN IMPROVED ESTIMATE Technical Summary Report
F. V. Atkinson Dec. 1963 31 p refs
(Contract DA-11-022-ORD-2059)
(MRC-428; AD-433881)

Given n complex numbers, of which at least one has a modulus not less than unity, it is shown that for at least one k, $1 \leq k \leq n$, the sum of the kth powers of these numbers exceeds 1/3. This improves on earlier estimates of 1/6, or 1/5 for $n \geq 8\pi$. The problem has an application to the numerical solution of algebraic equations. Author

N64-18299* Martin Co., Baltimore, Md. Research Inst. for Advanced Study
GENERALIZED CURVES AND THE EXISTENCE OF OPTIMAL CONTROLS
R. A. Gambill Feb. 1963 28 p refs
(NASA Contract NASr-103; Contract AF 49(638)-382)
(NASA CR-53346; Tech. Rept. 63-2) OTS: $2.60 ph

A method in the calculus of variations is used to analyze problems in optimal control. Generally, the results of this note are simple translations of results already obtained by McShane for generalized curves in parametric form. The notations of McShane's paper and of the paper of Botts are used in the development. R.T.K.

N64-18314 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ADAPTIVE CONTROL SYSTEMS: AN ANNOTATED BIBLIOGRAPHY [1960–Jul. 1963]
Jack B. Goldmann, comp. Sep. 1963 90 p refs
(Contract AF 04(695)-383)
(Rept. 2-75-63-1; SB-63-60; AD-433807)

The application of adaptive control systems to communications systems, automatic reconnaissance techniques, detection of weak signals in noise, and reliability enhancement are the areas of interest emphasized in this annotated bibliography. The references included in the body of this work are concerned with time-varying systems, self-optimizing control systems, predictive adaptive controls, optimalizing control systems, self-learning systems, adaptive principles, automatic optimizers, adaptive servo mechanisms, and extremum control. Author

N64-18345 Autonetics, Anaheim, Calif.
A GENERALIZED MATHEMATICAL METHOD FOR ESTIMATING SYSTEM RELIABILITY
Louis Schneider 1 Nov. 1963 31 p refs For presentation at the ASQC Conv., Buffalo

A mathematical model was developed that describes the life cycle of a system from assembly to degradation. Subsequently, the model was applied to typical production systems in order to provide estimates of the following parameters: (1) the number of debugging failures; (2) the number of hours required to debug the system; (3) the constant failure rate in percent per thousand hours; (4) the mean-time-between-failure; and (5) the percentage of debugging failures removed after test increments comprising 50 hours. The technique was then applied to a composite comprising 24 systems of homogeneous design. The composite curve approach provided the following reliability information: (1) the average number of system-debugging failures; (2) the average or maximum number of hours required for system debugging; and (3) a system average constant failure rate and the mean-time-between-failure. This technique can also be successfully applied to time-to-failure data at the module level. I.v.L.

N64-18346 Autonetics, Downey, Calif.
MANDEX, A WORST-CASE CIRCUIT ANALYSIS COMPUTER PROGRAM
H. S. Scheffler, J. J. Duffy, and B. C. Spradlin (Battelle Mem. Inst.) Jun. 1962 41 p refs
(Publ.-550-A-20)

This paper explains the Modified AND EXpanded (MANDEX) worst-case circuit analysis program, which utilizes a digital computer to determine the effects of variation in circuit input and part parameter on circuit performance. In the MANDEX method, the computer calculates the first derivative of all the output variables with respect to the input parameters and, using these derivatives, sets the input parameters to their end-of-life condition, so that a worst-case solution for the output variable is obtained. The computer determines whether performance is acceptable at this worst-case condition, and prints circuit information accordingly. This procedure is repeated for all output variables. To perform this analysis, it is necessary that a mathematical model, which may be programed, be derived from this circuit. The value of the part parameters and their end-of-life limits, the mathematical equations describing the circuit output variables, and failure criteria must also be programed into the computer. Author

N64-18349 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
FRACTIONAL INTEGRAL OPERATORS AND HYPERGEOMETRIC FUNCTION TRANSFORM
T. P. Higgins May 1963 22 p refs
(Math. Note 296; D1-82-0251)

The representation of the gauss hypergeometric function as a fractional integral is used to derive a hypergeometric transform and its inversion. An integral operator approach is used that makes the derivation of both the "symmetric" and the "simple" forms for inversion quite direct. A special case, the Jacobi transform, is given for both cases, and the reduction is made to a Legendre function transform to obtain the "symmetric" inversion as well as to obtain one which is equivalent to the known "simple" one. E.W.

N64-18366 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics

CODING AND DECODING FOR TIME-DISCRETE AMPLITUDE-CONTINUOUS MEMORYLESS CHANNELS

Jacob Ziv (Ph.D. Thesis) 31 Jan. 1963 108 p refs

(Contract DA-36-039-SC-78108; Grant DA-SIG-36-039-61-G14)

(RLE-TR-399; AD-299016)

A scheme for constructing a discrete signal space, for which sequential encoding-decoding methods are possible for the general continuous memoryless channel, is described. Random code selection is considered from a finite ensemble. The engineering advantage is that each code word is sequentially generated from a small number of basic waveforms. The effects of these signal-space constraints on the average probability of error, for different signal-power constraints, are also discussed. The application of sequential decoding to the continuous asymmetric channel is discussed. A new decoding scheme for convolutional codes, called successive decoding, is introduced. This new decoding scheme yields a bound on the average number of decoding computations for asymmetric channels that is tighter than has yet been obtained for sequential decoding. The corresponding probabilities of error of the two decoding schemes are also discussed. The quantization at the receiver and its effects on probability of error and receiver complexity are considered. Author

N64-18375 Wisconsin U., Madison Mathematics Research Center

ON THE ASYMPTOTIC JOINT NORMALITY OF QUANTILES FROM A MULTIVARIATE DISTRIBUTION Technical Summary Report

Lionel Weiss Dec. 1963 9 p refs

(Contract DA-11-022-ORD-2059)

(MRC-446; AD-433877)

A simple proof is given of the asymptotic joint normality of sample quantiles from a multivariate population, under very mild conditions. The joint cumulative distribution function of the quantiles is studied, rather than the joint probability density function. Author

N64-18377 Wisconsin U., Madison Mathematics Research Center

DECISION PROCEDURES FOR FINITE DECISION PROBLEMS UNDER COMPLETE IGNORANCE Technical Summary Report

B. Harris, F. V. Atkinson, and J. D. Church Jan. 1964 33 p refs

(Contract DA-11-022-ORD-2059)

(MRC-445; AD-433878)

Consider the triplet (S,D,u), where $S = \{s_1, s_2, \ldots, s_n\}$ is a set of n states of Nature, $D = \{d_1, d_2, \ldots, d_m\}$ is a set of m strategies available to the statistician, and u is a real-valued function on $D \times S$ such that $u(d_i, s_j)$ is the loss (negative utility) incurred by the statistician upon choosing d_i when Nature is in state s_j. A decision procedure is determined for choosing a mixed strategy $\phi \in \Phi$ where Φ is the $m - 1$ dimensional probability simplex over D. Let Ξ be the $n - 1$ dimensional probability simplex over S. A mixed strategy for Nature is an element $\xi \in \Xi$. The statistician may have the information that $\xi \in \Xi_0 \subset \Xi$. If $\Xi_0 = \Xi$, the statistician is said to be in complete ignorance. A set of desirable properties is developed for decision procedures for use in the above decision problem under the hypothesis of complete ignorance. It is shown that there exists a family of decision procedures, each of which satisfies all required properties. An algorithm for determining optimal strategies is given. Author

N64-18379 Wisconsin U., Madison Mathematics Research Center

THE STRUCTURE OF THE SOLUTION SET FOR A GENERALIZED REDUCED HAUSDORFF MOMENT PROBLEM Technical Summary Report

E. B. Cobb and Bernard Harris Jan. 1964 21 p refs

(Contract DA-11-022-ORD-2059)

(MRC-453; AD-433876)

The solution set for a generalized reduced Hausdorff moment problem is shown to be the closure of the convex hull of cumulative distribution functions with "small" spectra. Author

N64-18380 Wisconsin U., Madison Mathematics Research Center

THEOREMS OF GERSGORINTYPE Technical Summary Report

J. L. Brenner (Stanford Res. Inst.) Jan. 1964 10 p refs

(Contract DA-11-022-ORD-2059)

(MRC-454; AD-433879)

For a matrix of polynomials, of complex numbers, of real numbers, or of linear operators, the dominant main diagonal condition guarantees nonsingularity. This condition can be generalized to matrix partitionings in several ways, and most of these generalizations can be further generalized. The new theorems have as corollaries new results on location of proper values of matrices. Author

N64-18383 Stanford U., Calif.

THE CONVERGENCE OF A RANDOM DISTRIBUTION FUNCTION ASSOCIATED WITH A BRANCHING PROCESS

P. E. Ney 12 Mar. 1964 26 p refs

(Contract Nonr-225(52))

(Tech. Rept.-96; AD-434059)

The process under consideration is a "general" branching process. It is constructed from the standard branching process by associating with each particle a "type", namely a point $\underline{x}$ in a space Ω, which in this paper is taken to be d-dimensional Euclidian space. Thus at any given time, each particle existing at that time is considered as located at a point in Ω. In various applications the coordinates of $\underline{x}$ are such quantities as the energy, size, age, or location of the associated particle.) The diffusion of the particles throughout Ω is studied. It is demonstrated that the branching character of the process alone implies detailed results about its asymptotic behavior, without requiring any specific distribution assumptions. R.T.K.

N64-18399 Joint Publications Research Service, Washington, D.C.

DETERMINING THE DISTRIBUTION FUNCTION FOR LENGTH OF MAXIMUM CARRY

V. M. Mikhelev 7 Apr. 1964 12 p refs Transl. into ENGLISH from Zh. Vychistitel'noi Mat. i Mat. Fiz. (Moscow), v. 3, no. 5, Sep.-Oct. 1963 p 942-949

(JPRS-24073; OTS-64-31010) OTS: $0.50

An approach to the construction of a logic system for carry propagation is described. The basis of this system is the utilization of a distribution function for the length of maximum carries. In this system, the length of maximum carry is the equivalent of the carry propagation time during the addition of two numbers. R.T.K.

N64-18424* Queensland U., Brisbane (Australia)
AN INFINITE CLASS OF PERIODIC SOLUTIONS OF $\ddot{x}+2x^3=p(t)$
G. R. Morris [1958] 14 p refs Work done in conjunction with RIAS, Baltimore, Md.
(NASA Contract NASw-845; Contract AF 49(638)-1242; Contract Nonr-3693(00))
(NASA CR-53562) OTS: $1.60 ph

It is shown that the equation $\ddot{x} + 2x^3 = p(t)$ [where p(t) is periodic but not necessarily even] has an infinite number of periodic solutions. More specifically, it is shown that if: p(t) is continuously differentiable, has a least period of 2π, and $\int_0^{2\pi} p(t)dt = 0$. Then: for any positive integer m, the equation $\ddot{x} + 2x^3 = p(t)$ has an infinite number of periodic solutions with least periods of $2m\pi$. P.V.E.

N64-18425* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A MICROELECTRONIC ANALOG-TO-DIGITAL CONVERTER AND SYNC GENERATOR
J. Denton Allen 6 Feb. 1964 25 p refs
(NASA Contract NAS7-100)
(NASA CR-53561; JPL-TR-32-569) OTS: $2.60 ph

This report describes the application of thin-film passive components and planar transistor technology to the fabrication of an analog-to-digital converter and sync generator for use in spacecraft television. The analog-to-digital converter selected is described and compared with other types that were considered. Fabrication technology is discussed, and material selection criteria are presented. It is concluded that the combination of semiconductor and thin-film techniques discussed offers considerable advantages in this and other microelectronic applications. Author

N64-18429* California U., Berkeley Space Sciences Lab.
ON THE EVALUATION OF OPTIMAL AND NON-OPTIMAL CONTROL STRATEGIES
E. Polak 27 Feb. 1964 9 p refs Submitted for Publication
(NASA Grant NsG-354)
(NASA CR-53593; *Its* Ser. 5, issue 12) OTS: $1.10 ph

Methods for evaluating two figures of merit are presented. One figure of merit represents the average estimated cost of the process; the other represents the maximum possible cost for a single transition inside the given set (a closed bounded set in the state space) and is, in fact, the maximum estimated cost for a single transition. The figures of merit are applied to pulse-amplitude modulation and pulse-width modulation regulator systems. I.v.L.

N64-18430* California U., Berkeley Space Sciences Lab.
THEORY OF A CLASS OF DISCRETE OPTIMAL CONTROL SYSTEMS
B. W. Jordan and E. Polak 17 Jan. 1964 23 p refs
(NASA Grant NsG-354; AF Grant AFOSR 139-63)
(NASA CR-53583; *Its* Ser. 5, Issue 18) OTS: $2.60 ph

The problem considered in this paper is that of finding optimal controls for a class of fixed duration processes in systems described by nonlinear difference equations. The discrete versions of the adjoint system and the Hamiltonian are used in conjunction with the original techniques found in the proofs of the Pontryagin Maximum Principle to derive conditions necessary for a control to be optimal. These necessary conditions are shown to be related to the Pontryagin conditions for continuous systems in the following manner: the requirement of a global maximum of a Hamiltonian becomes a condition of local maximum or of stationarity, and the transversality conditions remain identical. Author

N64-18447* Martin Co., Baltimore, Md. RIAS Div.
SOME APPLICATIONS OF STOCHASTIC DIFFERENTIAL EQUATIONS TO OPTIMAL NONLINEAR FILTERING
W. M. Wonham Feb. 1964 35 p refs
(NASA Contract NASw-845; Contract AF 49(638)-1206)
(NASA CR-53567; RIAS-TR-64-3) OTS: $3.60 ph

A current problem in control theory is that of estimating the dynamical state of a physical system on the basis of data perturbed by noise. In the present report, filters (i.e., analog devices) that generate the posterior probability distribution, when its input is the time function actually observed, are defined by means of stochastic differential equations for the posterior distribution in which the observed time function appears as a forcing term. R.T.K.

N64-18452* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SET OF ALGORITHMS FOR A DIAGNOSABLE ARITHMETIC UNIT
Algirdas Avizienis 1 Mar. 1964 34 p refs
(NASA Contract NAS7-100)
(NASA CR-53575; JPL-TR-32-546) OTS: $3.60 ph

The design of a diagnosable arithmetic unit for a digital computer is discussed. Arithmetical errors are classified, and the effects of a circuit failure on an arithmetical result are considered. The methods of hardware (wired-in) checking of arithmetic are reviewed, and the cost of checking is proposed as a merit criterion. A low-cost checking algorithm for product-coded numbers is presented, and its effectiveness is evaluated with respect to various types of errors. A complete set of arithmetical algorithms for product-coded numbers is also presented. The algorithms are especially economical when the product code is chosen for the proposed low-cost checking algorithm. Author

N64-18466 Stanford U., Calif.
ON AGE DEPENDENT BRANCHING PROCESSES
Howard Weiner 27 Jan. 1964 79 p refs
(Contract Nonr-225(52))
(Tech. Rept. 94; AD-430995)

The asymptotic properties of various models of age-dependent branching processes are discussed. The discussion is divided into three parts. Part I considers cell growth in which a cell proceeds in a sequential manner through n independent states, state R with its life distribution F_R, R = 1,2,....,n. At the end of mitosis, the n^{th} state, the cell divides into similar cells, the number of which is governed by a generating function h, independent of the time and other cells of the process. Part II considers the random variable N(t) ≡ the total number of births by time t in a simple age-dependent branching process for m > 1 (increasing cell populations). Part III treats the case of two types of cells, of which only one type may divide, whereas the other either accumulates or is eventually absorbed in the medium (e.g., the production of stem cells and red-blood cells from parent stem cells). P.V.E.

N64-18476* Emerson Electric Mfg. Co., St. Louis, Mo. Electronics and Space Div.
DIGITAL ADAPTIVE CONTROL SYSTEM RESEARCH Quarterly Progress Report No. 4, 1 Nov. 1963-31 Jan. 1964
John Zaborszky, Wayne L. Humphrey, Richard E. Janitch, Louis M. Woltmann, and E. Edward Buder 21 Feb. 1964 54 p refs
(NASA Contract NASw-599)
(NASA CR-53610; Rept. 1544-4) OTS: $5.60 ph

Theoretical studies include a general basis for controls of the type being studied, based on plant description by Volterra Series. The previously developed control methods of the project are identified as special cases. The computational requirements

of a control computer for this system are identified. Feasibility of on-line operation with relatively modest computers is shown. A variety of experimental results are presented. Most notable is the hybrid simulation with filtering, which is a simulation of the complete control process. A glossary is presented of all equation and simulation symbols used in this and all previous progress reports. Author

N64-18492 Atomic Energy of Canada Ltd., Chalk River, Ontario
PERIGEE COMPUTER CODES FOR REACTOR SIMULATION IN 3 DIMENSIONS, USING 1 OR 2 NEUTRON VELOCITY GROUPS
A. P. Olson Feb. 1964 110 p refs
(AECL-1901; CRRP-1184)

PERIGEE is a code written in SNAP for the G-20 computer. The positions of mesh points along a fuel channel, relative to points in adjacent channels, may correspond to either NPD or CANDU fuel-bundle positions. The extrapolated flux boundary may be specified in sufficient detail to represent a tapered or stepped circumferential reflector, a variable axial length, and for a reactor with axis horizontal, a variable moderator level and a variable plane bottom surface equivalent to the CANDU dump structure. The neutron flux may be normalized to give a specified power output from the hottest fuel bundle or hottest channel, or to give a total thermal power limited by the turbine and generator. Reactor operation may be simulated in finite time steps, taking into account any fuel shifts, any changes in moderator level, and the change in nuclear properties of the fuel with increasing irradiation. The appropriate properties are obtained by interpolation from tables supplied for as many as 8 types of fuel bundle. Author

N64-18498* California U., Berkeley. Lawrence Radiation Lab.
ON SOME TOPOLOGICAL PROPERTIES OF THE SYSTEMS OF COMPARTMENTS
Aldo Rescigno and Giorgio Segre (Harvard U.) Repr. from Bull. Math. Biophys., v. 26, 1964 p 31–38 refs
(NASA Order R-104; jointly supported by AEC)

Compartment systems are often used as models for tracer and drug kinetics. The structure of a compartment system is analyzed by means of the theory of graphs. In particular, the precursor–successor relationship between any two compartments is classified according to the structure of the graph of the system and to the values of the elements of the matrix associated with it. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-17906* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS I METEOROLOGICAL SATELLITE SYSTEM Final Report
1962 264 p refs Prepared jointly with the staff of Weather Bureau
(NASA TR R-131) GPO: $2.25

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APPENDIX A. GEOPHYSICAL LOCATION OF CLOUD FEATURES R. C. Doolittle (Naval Photo. Interpretation Center) p 241–255

N64-17909* Weather Bureau, Washington, D.C. Meteorological Satellite Lab.
A CYCLONE OVER THE ATLANTIC OCEAN
Sigmund Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 119–129 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

TIROS I photographs of a cloud system associated with a well-developed cyclonic vortex, centered about 400 miles west of Ireland, are discussed. Stratiform clouds observed in the photographs were associated with a warm, moist tongue of air that encircled cold, relatively dry air in the center of the vortex over the Atlantic Ocean. This cold air, apparently cut off from its source, was associated with a nonovercast, galaxy-like cloud area, which was surrounded by the stratiform cloud. The region between the cold and warm air was of maximum jetlike winds, and was, as expected, near the inner edge of the stratiform cloud. Cloud streets, which cannot be seen from

surface observations, served to outline the windflow in the mature storm in which the wind direction did not change significantly with height. P.V.E.

N64-17910* Weather Bureau, Washington, D.C. Meteorological Satellite Lab.

A CUT-OFF CYCLONE OVER THE EASTERN PACIFIC

Jay S. Winston *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 131–150 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

The TIROS I cloud pictures show the details of the cloud structure around portions of a cutoff cyclone in the eastern Pacific in strikingly clear fashion. It has been shown that some of the major cloud bands in the southwestern portion of this cyclone were nearly perpendicular to the wind direction at both the surface and aloft. One of the most pronounced of these bands was identified as a secondary cold front along which the cyclonic development took place. The cloud patterns viewed by TIROS I suggest possible modifications in estimates of large-scale vertical motion in the lower and middle troposphere. Author

N64-17911* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.

AN OCCLUDED CYCLONE OVER THE GULF OF ALASKA

Jay S. Winston and Lloyd Tourville *In* NASA. Goddard Space Flight Center, Tiros I Meteorol. Satellite System 1962 p 151–165 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

Details of the cloud structure of the occluded cyclone and its periphery, which could never be determined from the available standard observations, have been clearly revealed in the TIROS I pictures. The following features have been documented: (1) cyclonically curved streaks in the dense cloudiness around the inner core of the cyclone; these parallel the surface isobars; (2) a "moat" of clear air spiraling into the center of the cyclone from the northeast; (3) the location and extent of broad bands of stratiform cloudiness associated with the main polar front; (4) the pattern of overrunning cloudiness associated with a nascent wave cyclone; (5) the previously undetected presence of an old cyclonic vortex in the middle troposphere; and (6) the striking cellular arrangement of cumuliform cloudiness in the cyclonic flow to the rear of the storm. Author

N64-17912* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.

THE MIDWEST STORM OF APRIL 1, 1960

Charles L. Bristor and Mary Ann Ruzecki *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 167–181 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

In the present descriptive study, standard meteorological measurements over a dense data network have been compared to TIROS I cloud photographs for a particular synoptic situation. The utility of such a wealth of photographic information over a broad land expanse has been suggested by these comparisons. It appears likely that a series of such studies can generate semi-empirical relationships that would be of great assistance in making adjustments and corrections to the analysis of upper-air charts over sparse data areas. In a more quantitative vein, a method has been suggested whereby such cloud data could be used in a computer-produced objective map analysis. Author

N64-17913* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.

A SUBTROPICAL CONVERGENCE BAND OF THE SOUTH PACIFIC

Lester F. Hubert *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 183–197 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

This study has shown that a dense (by tropical standards) network of surface observations provided only a rough indication of lines of convergence in the low troposphere. Based only on surface cloud data, the presence of disturbed weather near the major convergence line was suggested, but form surface reports alone it was not possible to delineate a continuous band of clouds or a continuous convergence line. An excellent surface data network in the tropics is not adequate to describe the quasi-stationary type of system studied here because the effect on the field of horizontal motion is so small that it is virtually undetectable. The standard data must be complemented by more complete cloud observations. The photographs obtained on the four orbits showed nearly 2,000 miles of a vigorous band of middle and low clouds that apparengly maintained its position over the main convergence asymptote at the surface. Author

N64-17914* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.

COMPARISON OF A SATELLITE NEPHANALYSIS WITH A CONVENTIONAL WEATHER ANALYSIS FOR A FAMILY OF PACIFIC FRONTAL STORMS

Vincent J. Oliver *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 199–203 refs (See N64-17906 10-21) GPO: $2.25

A series of pictures taken by TIROS I over the Western United States and the Northeastern Pacific are discussed. The area contained three quite active frontal systems, all clearly detectable in the cloud distribution shown by the satellite pictures. Several features of the pictures showed the ability of the satellite to reveal patterns, both large and small in scale, that are rarely, if ever, detectable from the ground. It is concluded that satellite data make possible, for the first time, the accurate, timely analysis of the "state of the sky." On many occasions, storm centers, frontal zones, jet streams, and the positions of clear areas can be placed more accurately than ever before, especially over the oceans. Many details in the patterns of each storm are unique to the storm and may remain with it from birth to maturity. Continuous satellite pictures of these patterns will make available to the forecaster the much needed "cyclone print." P.V.E.

N64-17915* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.

A CELLULAR CLOUD PATTERN REVEALED BY TIROS I

Arthur F. Krueger and Sigmund Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellites System 1962 p 205–212 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

A study of the synoptic observations accompanying the three satellite pictures of cellular cloud formations described in this report indicated that: (1) a layer of moist air about 5,000 feet deep was heated at the ocean surface, resulting in an adiabatic lapse rate; (2) superimposed over this layer was another of greater stability that served to inhibit the convection; and (3) throughout the convective layer there appeared to be little variation in wind speed and direction above that portion influenced by surface friction. These distinctive cloud patterns have the appearance of Bénard cells. There are, however, many important physical differences between the patterns observed by TIROS I and those observed in the laboratory. Author

N64-17916* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.
CLOUD STREETS IN THE CARIBBEAN SEA
John Schuetz and Sigmung Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. System 1962 p 213-220 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

The TIROS narrow-angle camera presents a means of determining such factors as orientation, spacing, and length of cloud streets. In this study, the streets were aligned within 30 degrees of the wind direction in the convective layer. The spacing of the streets over heated land was much less than those over the ocean. The length of the streets over the larger islands appeared to be related to the distance across the island in the direction of the windflow. Author

N64-17917* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.
A TORNADO-PRODUCING CLOUD MASS SEEN FROM TIROS I
Linwood F. Whitney, Jr. and Sigmund Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 221-231 refs Submitted for Publication (See N64-17906 10-21) GPO: $2.25

There is strong evidence that: (1) the first intense cumulus buildups in the Southern Plains on the afternoon of May 19, 1960, were represented by an isolated, "square" cloud mass; (2) the cloud was in an area possessing characteristics commonly found in tornado development; and (3) this cloud mass later expanded and spread northeastward, spawning hail and tornadoes in central Oklahoma. The shape of this cloud mass can be considered only as coincidental. It is not the intent here to imply that every bright isolated cloud mass seen from satellite vehicles will be associated with hail and tornadoes. However, such clouds, or masses of clouds, when considered together with the geographic location, the climatology of the region, and the existing synoptic situation, will be subject to close scrutiny as potential producers of severe local storms. Author

N64-17918* Weather Bureau, Washington, D.C. Meteorological Satellite Labs.
MISCELLANEOUS TIROS PICTURES
Sigmund Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 233-240 refs (See N64-17906 10-21) GPO: $2.25

A brief discussion is presented of several categories of miscellaneous TIROS I pictures. These pictures include those taken of: (1) mountain phenomena along the European Alps and the Sierra Nevada Mountains; (2) ice in the Gulf of St. Lawrence; (3) sun glitter (reflection of sunlight on the oceans); (4) Gulf Stream clouds; and (5) Southern Hemisphere cloud formations. P.V.E.

N64-18095 Massachusetts Inst. of Tech., Cambridge
LONG-TERM SOLAR-CLIMATIC RELATIONSHIPS Final Scientific Report
H. C. Willett and J. T. Prohaska 1 Oct. 1963 115 p refs
(NSF Grant 14077)

This report contains the final results of studies of long-term solar-climatic relationships. These results are discussed under the following topic headings: (1) the correlation of solar and climatic indices; (2) manifestations of the double sunspot cycle (1899 to 1962) in: (a) phase variations of the solar and the climatic indices; and (b) mean hemispheric circulation patterns; and (3) hemispheric circulation and climatic anomalies associated with extremes of solar activity. I.v.L.

N64-18180 Stanford Research Inst., Menlo Park, Calif.
THE SYNOPTIC CLIMATOLOGY OF CLOUD-FREE AREAS Scientific Report 1
John E. Adler Jan. 1964 82 p refs
(Contract AF 19(628)-2363)
(AFCRL-64-229; AD-433504)

This report discusses the results of an investigation of the synoptic patterns and airmass characteristics associated with areas of 500,000 square nautical miles or more over high-latitude continental regions of the Northern Hemisphere that were coded as clear on nephanalyses of TIROS pictures. The published nephanalyses of TIROS I through TIROS V were examined to locate such clear areas, which were then cataloged according to synoptic type and region. Persistence, extent, and displacement, if any, of these clear areas were also investigated. Author

N64-18181 Stanford Research Inst., Menlo Park, Calif.
THE SYNOPTIC CLIMATOLOGY OF CLOUD-FREE AREAS Final Report
Sidney M. Serebreny and John E. Adler Jan. 1964 22 p refs
For abstract see N64-18180 10-21
(Contract AF 19(628)-2363)
(AFCRL-64-230; AD-433503)

N64-18192 Deutscher Wetterdienst, Offenbach/AM (W. Germany)
ON THE BEHAVIOUR OF DISTURBANCES IN A BAROCLINIC CHANNEL
W. Edelmann 30 Apr. 1963 35 p refs
(Contract AF 61(052)-373)
(AFCRL-64-109; Tech. Note 7)

With the use of a 5-level model starting with a long-wave barotropic initial disturbance, two forecasts over 12 days were computed, including and excluding skin friction. Within a period of a few days, warm front, cold front, occlusion, warm front waves, cold front waves, new cyclones, and anticyclones of different types developed. Later on, examples of frontolysis, cyclolysis, and the disappearing of anticyclones were observed. Without skin friction the results do not look very realistic; however, by including skin friction the results simulate very closely a real weather development. Author

N64-18220 General Dynamics/Astronautics, San Diego, Calif.
WEATHER SATELLITE DATA PROCESSING Final Report, Aug. 1961-Jan. 1964
Walter A. Marggraf Bedford, Mass., AFCRL, Jan. 1964 101 p refs
(Contract AF 19(604)-8861)
(GD/A-DBB64-002; AFCRL-64-62; AD-433731)

This report describes the result of the Meteorological Satellite Data Processing Study. Three working areas are documented: (1) automatic mosaics of rectified TIROS video data, (2) infrared visual correlation of TIROS radiometer data, and (3) analysis of cloud distribution from TIROS rectified mosaics. Examples of rectified mosaics at different resolutions for seven selected TIROS orbits are included. Author

N64-18221 McGill U., Montreal (Canada) Arctic Meteorology Research Group
RADIATION BALANCE OF THE TROPOSPHERE AND OF THE EARTH-ATMOSPHERE SYSTEM IN THE ARCTIC Scientific Report No. 9
E. Vowinckel and Svenn Orvig Jan. 1964 51 p refs
(Contract AF 19(604)-7415)
(*Its* Publ. in Meteorology 63; AFCRL-64-35; AD-433672)

It is important to know the radiation terms for the top of the troposphere, as such values allow the determination of the

energy gain and loss for the atmosphere–earth system as a whole. A comparison of the balance at the surface and at 300 mb makes possible some assessment of the magnitude of nonradiative processes. The radiation terms not previously discussed are first calculated. These are shortwave radiation absorbed in the atmosphere, and upward longwave radiation loss to space. The results are then presented—first, the radiation balance of the troposphere, and next, the balance for the earth–atmosphere system. The monthly values of the various components of the radiation balance are illustrated and discussed for characteristic geographical points. Monthly maps of radiation balance (earth–atmosphere) are presented and discussed. Author

N64-18272 Isotopes, Inc., Westwood, N.J.
PROJECT STAR DUST Seventh Quarterly Report
James P. Friend, Herbert W. Feely, and Micah W. M. Leo 1 Feb. 1963 39 p
(Contract DA-49-146-XZ-079)
(DASA 1307; AD-432153)

Project Star Dust is reviewed. Current versions of the Star Dust model of atmospheric mixing and circulation have duplicated satisfactorily the observed behavior of the W^{185}, which was injected into the tropical stratosphere during mid-1958. The rate of deposition on the earth's surface and the latitudinal distribution of the deposit have been adequately reproduced, as well as the rate of decrease of the maximum concentration in the stratosphere and the rate of lateral movement of the point at which one-half of this maximum concentration is reached. However, the models have been unable to reproduce the observed poleward slope of the level of maximum concentration. Gamma spectra of samples collected during January 1963 showed the presence of Sb^{124} in fresh debris that must have been produced during the December 1962 Soviet tests. In addition, the atmospheric burden of Sr^{90} increased to approximately 6.4 megacuries as the result of the 1962 Soviet test series. During May to August 1962, atmospheric Mn^{54}, Fe^{55}, Co^{57}, Sb^{124}, and Ti^{204} increased. The C^{14} concentration in ground-level air in northern New Jersey decreased during the winter of 1962–1963. I.v.L.

N64-18347 Joint Publications Research Service, Washington, D.C.
DISCUSSION OF ARTICLE ON THE CLIMATOLOGY OF HEAT BALANCE
M. I. Budyko 30 Mar. 1964 17 p refs Transl. into ENGLISH from Izvest. Akad. Nauk SSSR, Ser. Geog. (Moscow)
(JPRS-23924; OTS-64-21929) OTS: $0.50

This report takes issue with an article entitled "On the Climatology of Heat Balance" by A. S. Monin. M. I. Budyko states that Monin made no attempt to examine the status of this science, and that no survey is given of its chief directions. Instead, Monin discusses three questions that relate poorly to each other, of which the first two (dealing with correlations between climatic elements in calculating the mean values of the constituents of heat and water balances, and with the substantiation of the equation relating the heat and water balances) embrace only a small area of the climatology of heat balance. The third question discussed by Monin, on the physical factors of the thermal conditions of the Arctic, is a general problem of meteorology and only partially overlaps with heat-balance problems. I.v.L.

N64-18356 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
CHARACTERISTICS OF ACOUSTIC ATMOSPHERES
L. Edwin Williamson Mar. 1964 21 p refs
(ERDA-127; AD-434384)

Data from approximately 300 meteorological rocket soundings are analyzed to study the seasonal and geographical variations in the general atmospheric acoustic structure. Geographical categories are defined as subtropical, midlatitude, and subpolar, and meridional variations within these categories are briefly discussed. The winter and summer periods are determined by the direction of flow in the upper stratosphere, between the spring and fall reversal periods. Tentative results show that the mean acoustic structure exhibits significant temporal and spatial variations. For certain features in the mean acoustic profile, sound speed variations in excess of 25 m/sec may exist in a seasonal transition. Height differences of these features may exceed 3 km for either a seasonal or low-to-high latitude transition. Author

N64-18392 Chicago U., Ill.
PROPOSED MECHANISM OF HOOK ECHO FORMATION. A PRELIMINARY MESOSYNOPTIC ANALYSIS OF TORNADO CYCLONE CASE OF MAY 26, 1963
Tetsuya Fujita and Robbi Stuhmer Nov. 1963 39 p refs
(Grant Cwb WBG-8)
(Res. Paper 27)

An attempt is made to explain the mechanism of the hook echo formation on the southwest edge of an eastward moving cumulonimbus cell. The conditions necessary for originating a hook echo circulation through this proposed mechanism are: significant absolute vorticity within the subcloud layer, intense updraft to bring the low-level moist air into the cloud, and a vertical wind shear that steers the cumulonimbus cell with a velocity that is considerably different from that of the low-level winds. The Magnus effect acting upon the spiraling updraft is employed as the force that brings the hook echo circulation at low levels toward the southwest edge of the major thunderstorm cell. A kinematic diagram with the absolute tangential speed and the radius of the cyclone as coordinates is also presented. Author

N64-18394 National Aeronautical Lab., Bangalore (India)
A STUDY OF THE HOURLY WIND SPEEDS AT LUCKNOW FROM THE POINT OF VIEW OF WIND POWER UTILIZATION
R. Ramanathan and S. Viswanath Apr. 1963 22 p ref
(NAL-TN-WP-26-63)

The annual mean wind speed at Lucknow is 9 km/hr. The estimated annual energy output of a wind-driven machine having a cut-in speed of 8 km/hr, a swept area of 30 m^2, and an overall power coefficient of 12 percent is 1,320 kwh. The average amount of water that the WP-2 type windmill, with an overall power coefficient of 12 percent and a swept area of 23.6 m^2, can pump in a year is about 40,000 kl (about 23,800 gal/day). Author

N64-18404 United Air Lines, Inc., Chicago, Ill.
AIRPORT WEATHER ON THE UNITED AIR LINES SYSTEM
Henry T. Harrison 1 Jan. 1964 424 p refs
(UAL Meteorol. Circ. 55)

The following information is presented for each of the airports on the United Air Lines system: (1) brief topographical sketch and concise summary of main features; (2) climatological table and summary; and (3) annual wind roses for all-weather conditions and for bad weather. P.V.E.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-17999 Autonetics, Downey, Calif. Inertial Navigation Div.
STELLAR-INERTIAL NAVIGATION APPLIED TO CRUISE VEHICLES
Vern A. Blumhagen Apr. 1963 54 p refs
(Publ. 552-A-26)

Basic inertial navigation systems used in cruise applications will, in general, experience position errors that continue to increase with time. The unbounded errors (errors that continue to increase with time) are caused by platform gyro drifts and other sources of random error-driving functions within the system. Utilizing stellar information effectively eliminates gyro drift as a major source of error in the system. This paper deals with the concepts of utilizing stellar information in an inertial navigation system, with some consideration given to the aspects of supplementing the stellar-inertial system with reference velocity information. Author

N64-18157 Autonetics, Downey, Calif.
OPERATIONAL RECALIBRATION OF SHIPS INERTIAL NAVIGATION SYSTEM (SINS)
B. E. Bona and R. J. Smay Apr. 1963 37 p refs
(Publ. 552-A-27)

One of the chief deterrents to maintaining accurate position and attitude information in shipboard inertial navigation systems is the existence of bias drift rates in the system gyros. Accordingly, considerable effort has been expended in attempting to remove these drifts by some operational method. Given external position information at three arbitrary points in time, an estimate of these constant gyro drifts and the necessary corrections can be made. This paper describes a general method for deriving such schemes and evaluating them. One of these schemes that seems particularly desirable is evaluated for random gyro drift rates and inaccuracies in the external position information. Author

N64-18276 Autonetics, Downey, Calif.
ACCELEROMETERS FOR SPACE VEHICLE GUIDANCE
J. M. Slater [1959] 15 p refs

Accelerometers for space-vehicle guidance are reviewed. Specifications for accelerometer performance for the launching phase (from the earth), the midcourse phase, and the terminal or landing phase are given. The principle, advantages, and disadvantages of the following types of accelerometers are discussed: (1) gyropendulum accelerometers; (2) differentiating-feedback accelerometers; (3) accelerometers with electronic integrators; and (4) variable-frequency vibrator accelerometers. Also discussed are the sources of error in accelerometers. I.v.L.

N64-18389 Autonetics, Downey, Calif.
PRECISION NAVIGATIONAL EQUATIONS FOR NAVIGATION BY USE OF CW RADIO DOPPLER SIGNALS FROM EARTH SATELLITES
K. C. Kochi [1960] 30 p refs Prepared as part of Autonetics rept. TM-3241-69-141
(Contract NObs-78160)

This paper presents a detailed development of a set of navigation equations to be used by the navigator's computer to determine position utilizing radio Doppler signals from earth satellites. The present mechanization differs from the more commonly considered least-squares curve-fitting method in that the area between the received (observed) and calculated (predicted) Doppler curves is used to correct the receiver's estimated position. The mechanization incorporates a procedure that automatically determines the combined long-time frequency shift of the navigator's and satellite's receivers. Two alternate sets of navigation equations are developed. One set is in the standard latitude–longitude coordinates, and the other is in satellite cross-and-along track coordinates. The latter set is to be used to avoid the well-known "pole" problem when the receiver is in the vicinity of the earth's polar regions. Author

N64-18499* Control Data Corp., Minneapolis, Minn. Research Div.
FEASIBILITY STUDY OF A TRACK-WHILE-SCAN NAVIGATION CONCEPT. PROGRAM A-REVISIONS
Joseph E. Carroll 1 Oct. 1963 21 p refs
(NASA Contract NAS1-2902)
(NASA CR-53651; CDC-TM-9552-3) OTS: $2.60 ph

In a previous report, an extensive description of the program was undertaken together with derivations of some of the pertinent equations. In this report a number of minor errors are corrected. Of major importance, however, are changes in the least-squares-navigation computation. The minimum data attitude and position computations are correct as given previously, but are needlessly complicated by being computed together. Since stars contribute no information toward vehicle position, they can be evaluated separately, thereby greatly reducing the amount of computation required. In the previous least-squares analysis, the sum of the squares of the residuals of the function connecting the measured transit time and the vehicle unknowns was minimized. In this revision, the residuals of the measured quantities are measured instead. This work is detailed, together with the necessary equations. The method of statistically analyzing the list of errors in any of the six attitude and position values has been altered by computing additional moments of the distribution, plotting the distribution, and subjecting it to a χ^2 test. E.K.R.

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-17842 Aberdeen Proving Ground, Md. Ballistic Research Labs.
TRANSIENT RESPONSE OF WAX TARGETS TO PELLET IMPACT AT 4 KM/SEC
B. G. Karpov Oct. 1963 47 p refs
(Partially supported by ARPA)
(BRL-1226; AD-428221)

Observational data are given on shock and particle velocities, Hugoniot of wax, target deformation associated with crater formation, and Holloway's data on time history of crater growth. It is inferred that the pellet material penetrates into the target to the depth of 1.5 cm, and the target material contained in this volume, which is 20% of the final crater volume, is expelled. The remaining 80% of the crater grows in a relatively low-pressure field environment at moderate velocities. Wax data are compared with predictions of blast-wave theory. It is shown that blast-wave theory, as applied to wax target, is of very limited usefulness. In appendix A, estimates of temperatures in the vicinity of the impact are given. Author

N64-17856 Massachusetts Inst. of Tech., Cambridge
MEASUREMENT OF GAMMA-RAY SPECTRA FROM THERMAL-NEUTRON CAPTURE Scientific Report No. 1
John M. Neill (Ph.D. Thesis), Norman C. Rasmussen, and Theos J. Thompson Aug. 1963 184 p refs
(Contract AF 19(604)-7492)
(MITNE-37; AFCRL-63-341; AD-428321)

An investigation of the gamma-ray spectra of several isotopes from thermal-neutron capture has been carried out. The isotopes irradiated are Sc^{45}, Ir^{191}, Ir^{193}, Rh^{103}, Dy^{161}, Dy^{164}, and Ho^{165}. The instruments that have been employed are a 6-meter bent-crystal spectrometer at M.I.T. and a scintillation-pair spectrometer at Brookhaven National Laboratory. The results have been compiled, and nuclear energy level schemes have been proposed for Sc^{46}, and somewhat tentatively for Dy^{165} and Ho^{166}. Possible additions to the present nuclear energy level schemes of Rh^{104} and Dy^{162} are also presented. Author

N64-17857 New Mexico State U., University Park Research Center
AN OBSERVATIONAL STUDY OF ASTRONOMICAL SEEING AND AN INVESTIGATION OF INSTRUMENTATION DESIGNED TO REDUCE THE EFFECTS OF ATMOSPHERE-INDUCED IMAGE ABERRATIONS Final Report
Bradford A. Smith Oct. 1963 40 p refs
(Contract AF 19(604)-5535)
(AFCRL-63-217; AD-430050)

A study of telescopic image aberrations at Las Cruces, New Mexico, leads to generalizations on the local "seeing" behavior. Diurnal effects, as well as the effects of local winds, are included, along with the techniques used to study these aberrations. An investigation into the possibilities of image-aberration compensation is described. Attempts were made to compensate for image motion by means of a two-axis optical servo system. Although the system worked well on slowly oscillating images, it failed to fully correct for image motion at the frequencies encountered in normal planetary photography. Author

N64-17863 Manchester Coll. of Science and Tech. (Gt. Brit.) Simulation of Lunar Luminescence Lab.
A PROTON SOURCE FOR LUMINESCENCE EXCITATION Technical Note No. 2
C. J. Derham and J. E. Geake Sep. 1963 20 p refs
(Contract AF 61(052)-379)
(AFCRL-63-948; AD-430920)

Hydrogen gas at low pressure is ionized by a radio-frequency field. A single-stage system accelerates the protons produced to an energy that is adjustable from 5 to 120 kv at a beam current of up to 1 μa. The proton beam strikes a dust target on a temperature-controlled tray in an evacuated chamber. There is provision for alternative UV excitation of the sample in the same chamber. The luminescence radiation is analyzed by a recording photoelectric spectrophotometer. Author

N64-17868 Birmingham U. (Gt. Brit.)
PROPERTIES AND REACTIVITY OF GAS PHASE FREE RADICALS AND DEVELOPMENT OF MOLECULAR BEAM REACTOR Final Technical Report, 1 Feb. 1962-31 Jan. 1963
P. Millward et al 1963 84 p refs
(Contract DA-91-591-EUC-2149)
(AD-412955)

The development and applications of a technique for the study of the primary products of reactive bimolecular collisions are discussed. The method is based on passing a high-intensity molecular beam of one reactant through a vessel containing the second reactant at very low pressure and detecting the collision products by mass-spectrometer techniques. To apply the technique to reactive collisions between ordinary molecules, which usually have high activation energies (>20 kcals/gm mol), it is necessary that a large proportion of the reactant molecules have translational energies corresponding to temperatures of several thousand degrees. A high-intensity source of fast neutral molecules was designed and constructed. It consists of a thoriated tungsten filament and a nichrome anode and cathode. Initial experiments on the operation of the fast-beam source are reported. R.T.K.

N64-17872 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
FAR-FIELD RADIATION PATTERN
G. J. Lasher, F. Stern and K. Weiser *In its* Injection Laser Study [1963] p 29-32 refs (See N64-17870 10-25)

Numerical calculations are being conducted to determine the angular distribution of the far-field radiation pattern of an idealized three-region model of a laser. The active region and the two surrounding regions of the crystal are assumed to have constant, but usually differing, indices of refraction and absorption coefficients. From this model it will be possible to have a fairly complete description of the wave inside the crystal, its gain, and the far-field pattern. R.T.K.

N64-17899 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
ERRORS IN THE EVALUATION OF MOMENTS OF A PARAMAGNETIC RESONANCE LINE SHAPE
Henry S. Judeikis 13 Jan. 1964 19 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-2; TDR-269(4240-30)-5; AD-433560)

The systematic errors inherent in the numerical evaluation of the various moments of an experimental paramagnetic resonance line shape are discussed as a function of the choice of the arbitrary cutoff of wing contributions. Lorentz and Gaussian first derivative line shapes are used as models. Expressions for the zeroth, second, and fourth moments of these line shapes are derived in terms of generalized coordinates and the arbitrary cutoff. Use of the generalized coordinates, which contain parameters related to easily measured experimental quantities, permits application of the results to any line shape of the Lorentz or Gaussian form. Author

N64-17901 Massachusetts Inst. of Tech., Cambridge Research Inst. of Tech.
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION First Quarterly Technical Progress Report, 1 Sep. 1963-30 Nov. 1963
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas [1963] 35 p refs
(Contract AF 33(616)-1083)

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17. PENETRATION OF AN ION THROUGH AN IONIC DIPOLE LAYER AT AN ELECTRODE SURFACE J. W. Gadzuk p 23-31 refs (See N64-17905 10-23)

N64-17904 Massachusetts Inst. of Tech., Cambridge Research Inst. of Tech.

ELECTRON AND ION EMISSION FROM A TUNGSTEN MONOCRYSTAL

James L. Coggins *In its* Res. on New Concepts in Energy Conversion [1963] p 19-22 refs (See N64-17901 10-23)

The growth of a monocrystal tungsten filament and vacuum measurements of the electron emission from the filament are discussed. The crystal was grown in a projection tube by heating the filament at approximately 2,000° K for several hours. This procedure worked relatively well when using a specially doped wire (filament), GE-218 tungsten wire of pre-World War II variety. The quality of the crystal was monitored by applying a high voltage to the screen and by observing the emission pattern from the filament. The vacuum measurements were taken in a tube with a rotating slit, 1 cm long, which subtended an angle of 4.2° on the filament (0.003 in. in dia.). The parameters that can be varied are filament temperature, anode bias voltage, collector bias voltage, and direction. Both the anode and collector are normally run at a potential positive with respect to the filament. A typical collector bias curve is presented, as is the emission map of collector current versus azimuth. This map gives an indication of how the work function varies with crystallographic direction. The above mentioned investigations were conducted to gain a better understanding of the emission processes that occur at the electrodes of thermionic energy converters. I.v.L.

N64-17905 Massachusetts Inst. of Tech., Cambridge Research Inst. of Tech.

PENETRATION OF AN ION THROUGH AN IONIC DIPOLE LAYER AT AN ELECTRODE SURFACE

J. W. Gadzuk *In its* Res. on New Concepts in Energy Conversion p 23-31 refs (See N64-17901 10-23)

Theoretical values of the penetration coefficient of cesium ions, as a function of coverage, were derived for the cases of an immobile film and a completely mobile film. The values of the penetration coefficients of cesium on tungsten, computed from the Taylor-Langmuir data, fall between the theoretical values obtained for the above mentioned cases. I.v.L.

N64-17960 Utah U., Salt Lake City High Velocity Lab.

WAVE FRONT SOLUTIONS IN LINEAR AND NONLINEAR MEDIA

C. Eugene Mc Dermott and Neil P. Bailey May 1963 153 p refs

(Contract AF 04(694)-259)

(UU-12; BSD-TDR-63-131; AD-412302)

A study was made of plane, cylindrical, and spherical wave fronts in linear and nonlinear media caused by either a constant velocity or constant pressure impact condition. The classical wave equations were analyzed, and stress times area times velocity (SAV) was found to be constant at the wave front. This allowed the reduction of the wave front solutions to simple algebra. Strain gage measurements were used to verify the theory. Author

N64-17966 Louvain U. (Belgium) Lab. of Physical Chemistry

PHOTOVOLTAGES AND ADSORBED GASES IN CdS. INTERPRETATION OF HIGH FREQUENCY "FORMING" OF CdS SINGLE CRYSTALS. THERMOELECTRIC POWER OF ANNEALED AND COLD-WORKED BISMUTH Technical Note No. 5

André Luyckx, Jean-Paul Issi, Guy Lontie, Jacques Stoquart, Francis Leprince et al Dec. 1963 24 p refs Summaries of res. presented to the "Ann. Day of the Solid State Phys.," Belgian Soc. of Phys., 10 Nov. 1963 Submitted for Publication

(Contract AF 61(052)-166)

(RADC-TDR-64-95; AD-432040)

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1. PHOTOVOLTAGES, PHOTOCURRENTS AND ADSORBED GASES IN CdS SINGLE CRYSTALS Guy Lontie and André Luyckx p 2-6 refs
2. THERMOELECTRIC POWER OF ANNEALED AND COLD-WORKED BISMUTH Jean-Paul Issi and André Luyckx p 7-14 (See N64-17967 10-23)
3. HIGH FREQUENCY "FORMING" OF CADMIUM SULPHIDE SINGLE CRYSTALS Jacques Stoquart and André Luyckx p 15-19 refs (See N64-17968 10-25)

N64-17967 Louvain U. (Belgium) Lab. of Physical Chemistry

THERMOELECTRIC POWER OF ANNEALED AND COLD-WORKED BISMUTH

Jean-Paul Issi and André Luyckx *In its* Photovoltages and Adsorbed Gases in CdS. Interpretation of High Freq. "Forming" of CdS Single Crystals. Thermoele. Power of Annealed and Cold-Worked Bismuth Dec. 1963 p 7-14 (See N64-17966 10-23)

Pure bismuth (99.995 percent pure) was used in the experiment. One of the samples was melted in an argon atmosphere, and after being allowed to cool slowly, was abraded to a thickness of 0.05 mm. The structure of the sample was that of annealed polycrystalline bismuth. The second sample was subjected to the same heat treatments, then rolled at room temperature, to a thickness of 0.05 mm. The third sample was extruded through dies in the shape of a wire having a 0.3-mm diameter. The samples were mounted and put in an evacuated pyrex tube together with a holder. The temperature difference was maintained between 5° and 10° C by means of heaters. The absolute thermoelectric power was measured directly; the con-

necting leads consisted of pure Pb. Also, the absolute thermoelectric powers of the three samples were plotted against temperature. The cold-worked specimen exhibited a thermoelectric power at least 50% higher than that of the annealed sample for the entire range of temperature investigated. The bismuth wire (sample three), which was not subjected to such a severe permanent deformation, yielded intermediate values. R.T.K.

N64-17978 California U., Berkeley. Lawrence Radiation Lab.
PION-PROTON ELASTIC SCATTERING IN THE ENERGY RANGE 300 TO 700 MeV
Philip M. Ogden (Ph.D. Thesis) 20 Feb. 1964 98 p refs
(Contract W-7405-ENG-48)
(UCRL-11180) OTS: $2.25

Differential cross sections for elastic π–p scattering have been measured at eight energies for positive pions and seven energies for negative pions. Energies ranged from 310 to 650 Mev. A beam of pions from an internal BeO target was directed into a liquid-hydrogen target. Events were detected by a coincidence of pulses indicating the presence of an incident pion, scattered pion, and recoil proton, and the results were stored in the memory of a pulse-height analyzer. Various corrections were applied to the data, and a least-squares fit was made to the results at each energy. The form of the fitting function was a power series in the cosine of the center-of-mass angle of the scattered pion. Integration under the fitted curves gave values for the total elastic cross section. The importance of certain angular-momentum states, particularly the D_{13} state near 600 Mev, is discussed. Several possible explanations are given of the enhancement in the π^-–p cross sections near 600 Mev. Author

N64-17980 California U., Berkeley. Lawrence Radiation Lab.
NEUTRON AND ALPHA COUNTERS FOR HEAVY-ELEMENT COLUMN CHEMISTRY
Robert J. Walker, Tommy R. Corbin, and James T. Haley 18 Feb. 1964 12 p refs
(Contract W-7405-ENG-48)
(UCRL-11300) OTS: $0.50

Surface-barrier solid-state detectors have been developed for use as counters during column separation of the transplutonium elements. These detectors can function in the presence of approximately 10^9 n/sec and 10^5 R/hr of fission products. As an alpha counter, the detector has excellent discrimination against gamma and beta radiation, and is practically insensitive to fast neutrons. As a neutron counter, the detector (when equipped with a polyethylene converter foil) is insensitive to alpha but moderately sensitive to fast neutrons. Since fast neutron moderation is preferentially forward and the detector neutron sensitivity is unidirectional, the intense neutron background from the column itself does not affect the detector. The equipment and circuitry are described, and results of a typical Cf^{252} separation run are presented. M.P.G.

N64-17981 Rochester U., N.Y.
THE $C^{13}(\alpha,n)O^{16}$ REACTION BETWEEN 5.9 AND 8.4 MEV
V. K. Deshpande and H. W. Fulbright 11 Feb. 1964 13 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-8)

The $C^{13}(\alpha,n)O^{16}$ reaction leading to the ground state of O^{16} has been studied between 5.9 and 8.4 Mev. Strong resonance structure is observed in the O excitation curve, with peaks at 6.58, 7.02, 7.42, and 8.26 Mev. The angular distributions obtained at these four energies are analyzed on the basis of compound nucleus formation process. Levels of O^{17} with J = 5/2, 5/2, 3/2, 3/2 seem to contribute at the four respective peak positions. Author

N64-17982 Rochester U., N.Y.
A BOUNDARY CONDITION MODEL. I. ANTINUCLEON–NUCLEON SCATTERING
Martin S. Spergel (Ph.D. Thesis) 6 Mar. 1964 44 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-24)

An improved boundary condition plus elastic potential has been developed for calculating the elastic, charge exchange, and annihilation cross sections for the antinucleon–nucleon system in the nonrelativistic energy region (50 to 300 Mev in the laboratory system). The boundary condition is taken to maximize the absorption cross section in each channel of specified isotopic spin, ordinary spin, and total angular momentum. The elastic potential is constructed by modifying the one pion and two pion nucleon–nucleon potentials in the usual manner. The results fit the available data fairly well for both the differential elastic cross section and the total annihilation cross section. Charge-exchange scattering is found to be quite sensitive to the size of the core region. Author

N64-17998 Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1964
R. M. Adams and A. Glassner 15 Mar. 1964 113 p refs
(Contract W-31-109-ENG-38)
(ANL-6860) OTS: $2.25

Technical progress in both the specific reactor projects and in the general engineering research and development programs is reported. M.P.G.

N64-18002 Los Alamos Scientific Lab., N. Mex.
A COMPARISON OF THE NEUTRON DOSE RATES OBTAINED WITH THE SINGLE-SPHERE INSTRUMENT, MULTISPHERE METHOD, AND HURST PROPORTIONAL COUNTER
Dale E. Hankins and Raymond A. Pederson 13 Mar. 1964 25 p refs
(Contract W-7405-ENG-36)
(LAMS-2977) OTS: $0.50

This report compares the neutron dose rates obtained with the single-sphere neutron instrument, the multisphere method, and the Hurst proportional neutron counter, using PuBe and reactor-leakage neutrons. The results were in good agreement for fast-neutron spectra; but for spectra consisting of low- and intermediate-energy neutrons, the Hurst proportional counter reported dose rates lower than the multisphere method by ~35% and the single-sphere instrument reported dose rates higher than the multisphere method by ~60%. The results indicate that about 30% of the total dose rate would be missed by using a Hurst proportional counter for reactor survey work, and that the single-sphere instrument can be used for all types of survey work by applying a correction factor to the indicated dose rate. Author

N64-18004 Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
RETARDING POTENTIAL MEASUREMENTS OF ELECTRONS PHOTOEMITTED BY N_2, CO, AND O_2
Richard I. Schoen Nov. 1963 33 p refs
(DI-82-0315; Rept. 83)

Retarding potential measurements have been made on electrons emitted during the photoionization of N_2, O_2, and CO. More than half of the ions produced by radiation in the 700 A to 500 A interval were observed to be in states of electronic excitation. Vibrational excitation of the ground states of CO^+ and O_2^+ occurred in the wavelength intervals between the first and second ionization potentials. Part of the excitation of vibrational states was attributed to autoionization phenomena. Author

N64-18006 Laboratoire de Physique Théorique et des Hautes Energies, Orsay (France)
INTERMEDIATE BOSONS AND UNITARY SYMMETRY
B. d'Espagnat and Y. Villachon [1964] 27 p refs

The consequences of a hypothesis concerning the interactions of the intermediate bosons, w, are investigated. The hypothesis is that the fundamental nonleptonic interaction of the w's belongs to the fundamental representations of the group U_3 of unitary symmetry. It is recalled that the phenomenological rules $\Delta S \neq 2|\Delta I| \leq 1$ follow from this assumption, as well as the invariance of the nonleptonic weak interaction under the transformations of an SU_2 subgroup of U_3. Three models are possible, according to whether the w's belong to "3", "6", or "15". The first two are investigated in detail. Both are shown to be compatible with present experimental knowledge; both have distinctive features that could eventually be tested. The second one allows for some $\Delta S = -\Delta Q$ admixture and for a tentative interpretation of the ratio between the phenomenological vector β and μ decay coupling constants. Author

N64-18033 Naval Research Lab., Washington, D.C.
DISPLAY FIELD ENLARGEMENT THROUGH PERIPHERAL PRESENTATION OF EXTRA-FIELD ERROR
E. A. Cook and C. L. Tipton Feb. 1964 19 p refs
(NRL-1506; AD-433733)

This report provides a technique of peripherally extending a display field by presenting extra-field error in the form of an arc at the display's edge. Two experiments were conducted that characterized the influence of limiting display conditions, peripherally extended display conditions, and nonlimiting display conditions. The results indicate that the technique of peripheral display extension overcomes the adverse effects of display limiting. In fact, performance with a peripherally extended display was found to be comparable to performance obtained under a nonlimiting display condition. In addition, the results indicate that performance deteriorates when the ratio of the peripheral to the central display gain is less than one. Author

N64-18039 ARO, Inc., Arnold Air Force Station, Tenn.
CHARTS OF NORMAL SHOCK WAVE PROPERTIES IN IMPERFECT AIR
Clark H. Lewis and E. G. Burgess, Arnold Eng. Develop. Center, Mar. 1964 54 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-43; AD-433958)

Gas-dynamic properties, which include the effects of dissociation, ionization, and intermolecular forces (van der Walls), are presented for incident and reflected shock waves in equilibrium imperfect air. Charts are presented for incident shock Mach numbers in the range from 6 to 30 into (ideal) air at a temperature of 300° K and pressures in the range from 10^{-4} to 10^3 cm Hg. The temperature and density in any region do not exceed, respectively, 15,000° K and 158 amagats. In addition to the usual incident and reflected shock properties, stagnation conditions upstream and downstream and conditions immediately downstream of a standing shock wave are also presented. At pressures above one atmosphere in the undisturbed gas, the effects of the intermolecular forces on the gas-dynamic properties are demonstrated. Author

N64-18048 Midwest Research Inst., Kansas City, Mo.
ULTRASONIC WAVE PROPAGATION AND INTERACTION IN SOLID MATERIALS Technical Documentary Report, 1 Mar. 1963-28 Nov. 1963
F. R. Rollins and L. Taylor Wright-Patterson AFB, Ohio. Air Force Materials Lab., Mar. 1964 59 p refs
(Contract AF 33(657)-11006)
(ML-TDR-64-21, Pt. 1; AD-433193)

The interaction of ultrasonic beams in solid media has been investigated from both the theoretical and experimental viewpoint. An error in the previously reported classical calculation has been corrected, and relatively good qualitative agreement now exists between the classical and quantum mechanical calculations. Experiments are described that verify certain theoretical predictions concerning the magnitude of interaction and the conditions of resonance. Techniques have been devised for producing interaction in specimens of unusual shape. Furthermore, the feasibility of using interaction techniques in making a three-dimensional analysis of elastic anisotropy has been demonstrated. Author

N64-18053* Wisconsin U., Madison
REMOVAL OF ELECTRON-ELECTRON POLES FROM MANY-ELECTRON HAMILTONIANS
Joseph O. Hirschfelder Repr. from J. Chem. Phys., v. 39, no. 11, 1 Dec. 1963 p 3145-3146 refs
(NASA Grant NsG-275-62(4180))

In many-electron problems, the Hamiltonian has poles $1/r_{ij}$ that produce difficulties in the solution of the Schrödinger equation $H\psi = E\psi$. If ψ is taken to be $\phi\chi$ where $\phi = \Pi[1+1/2r_{ij}\exp(-\alpha r_{ij})]$, it is found that χ satisfies the new Schrödinger equation $H'\chi = E\chi$ where the new Hamiltonian H' has no electron–electron poles. Author

N64-18055 Oak Ridge National Lab., Tenn. Health Physics Div.
TIME-OF-FLIGHT STUDIES OF ELECTRONS IN VACUUM
D. A. La Bar (M.S. Thesis—Vanderbilt U.), J. A. Harter, and R. D. Birkhoff Apr. 1964 52 p refs
(Contract W-7405-ENG-26)
(ORNL-3484) OTS: $1.25

An electron beam monochromator is under development utilizing a time-of-flight velocity selection technique. An avalanche transistor pulser supplies nanosecond gating pulses to the negatively biased grid of an electron gun. Electrons are accelerated from a negatively biased filament into a drift tube aligned with the earth's magnetic field. The electrons in their passage through the drift tube 0.83 m in length spread out in energy with the more energetic getting to an aperture first. Velocity selection will be achieved by gating the electron beam in front of the aperture by either electrostatic or magnetic methods. Electrons able to pass through the aperture should be

monoenergetic within 0.01 ev, and these monoenergetic electrons can then be used in investigations of electronic energy levels in solids. Author

N64-18063 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
HITTING AND MARTINGALE CHARACTERIZATIONS OF ONE-DIMENSIONAL DIFFUSIONS
Michael A. Arbid (Ph.D. Thesis) 22 Feb. 1964 26 p refs
(Contract DA-36-039-SC-78108; Contract AF 33(616)-7783; Grant DA-SIG-36-039-61-G14; NSF Grant G-16526; NIH Grant NB-01865-05 et al)
(MIT-RLE-TR-419; AD-431997)

The main theorem of this report states that, for a large class of one-dimensional diffusions (i.e., strong Markov processes with continuous sample paths) if x(t) is a continuous stochastic process possessing the hitting probabilities and mean exit times of the given diffusion, then x(t) is Markovian, with the transition probabilities of the diffusion. For a diffusion x(t) with natural boundaries at $\pm\infty$, there is constructed a sequence $\pi_n(t,x)$ of functions with the property that the $\pi_n(t,x(t))$ are martingales, reducing in the case of the Brownian motion to the familiar martingale polynomials. It is shown that if a stochastic process x(t) is a martingale with continuous paths, with the additional property that $\int_0^{x(t)} m(0,y)\,dy - t$ is a martingale, then x(t) is a diffusion with generator $D_m D^+$ and natural boundaries at $\pm\infty$. Author

N64-18070 Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS, JANUARY 1964
William M. Leak, ed. 1964 56 p refs
(AD-428442) OTS: $1.25

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N64-18071 Naval Research Lab., Washington, D.C.
THE NRL 55-MEV-ELECTRON LINEAR ACCELERATOR (LINAC)
T. Godlove, R. Tobin, and J. Mc Elhinney *In its* Rept. of NRL Progr., Jan 1964 p 1–15 refs (see N64-18070 10-23)
OTS: $1.25

A 55-Mev linear accelerator has been constructed to provide high-intensity beams of electrons, positrons, X-rays, and neutrons for basic and applied research in nuclear and radiation physics. This paper describes the new facility and some of the planned research. Author

N64-18080* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPUTTERING AT OBLIQUE ANGLES OF ION INCIDENCE
Thomas W. Snouse Washington, NASA, Apr. 1964 27 p refs
(NASA TN D-2235) OTS: $0.75

The sputtering yield and angular distributions of sputtered material were measured for obliquely incident nitrogen ions of energy 0.5 to 7.0 kev on polycrystalline copper. Sputtering yields increased in proportion to $1/\cos\alpha$ as the angle of incidence, α, increased from 0° to 60°. Angular distributions of sputtered atoms were asymmetric with a peak away from the incident ion beam at low energies, but tended to become symmetric at higher energies. The high-energy distributions were peaked about the normal and were not cosine distributions. A model of monocrystalline and polycrystalline sputtering was constructed, based on the properties of collision events correlated because of crystal structure. Author

N64-18110* Rice U., Houston, Tex.
THE VELOCITY OF SHEAR FRACTURE
L. Mansinha Repr. from Bull. Seis. Soc. Am., v. 54, no. 1 Feb. 1964 p 369–376
(NASA Grant NsG-6-59)

The maximum velocity of fracture in a homogeneous, isotropic, elastic medium under pure shear stress and with an added compressive stress is computed by an extension of Yoffe's method. The maximum velocity of shear fracture is smaller than the velocity of transverse waves in the medium. It increases as Poisson's ratio increases and decreases as the compressive stress increases. The maximum velocity of pure shear fracture is higher than the velocity of pure tensile fracture in the same medium. For a medium with Poisson's ratio of 0.25 the former is 0.775 and the latter is 0.631 of the transverse wave velocity. Author

N64-18122 European Organization for Nuclear Research, Geneva (Switzerland)
ACCELERATION IN A PROTON SYNCHROTRON BY MEANS OF A TRAVELING WAVE STRUCTURE IN THE PASS-BAND REGION
W. Schnell 11 Feb. 1964 11 p refs
(CERN-64-10)

The efficiency of a traveling-wave structure in the pass-band region in a proton synchrotron is investigated and compared with both a set of fixed resonant cavities and a system of automatically tuned cavities. A theoretical consideration of a periodically loaded traveling-wave structure, whose phase velocity has been made equal to the particle velocity at the center of the frequency band $2\Delta f$, is presented. The comparisons show that: (1) The traveling-wave arrangement proposed is superior to the array of resonant cavities by a factor of 2.9. (2) However, the traveling-wave structure's power consumption is about 4 times greater than a system of mechanically tuned cavities that has been proposed for a 300-Gev machine. Nevertheless, the traveling-wave system might be advantageous for a very-high-intensity machine where beam loading absorbs a large amount of power anyway, and where a simple untuned structure is very desirable in view of radioactive-contamination and radiation-damage problems. M.P.G.

N64-18136* Rensselaer Polytechnic Inst., Troy, N.Y.
ORTHO- AND PARATRITIUM
E. W. Albers, P. Harteck, and R. R. Reeves Repr. from J. Am. Chem. Soc., v. 86, no. 204, 20 Jan. 1964 6 p refs
(NASA Grant NsG-158-61)

The conversion of orthotritium to paratritium in the homogeneous gas and solid phases has been studied. The extent of conversion was measured by a heat conductivity cell cooled with liquid neon to 27.2° K. The gas phase conversion was observed at 27.2° K, at which temperature the equilibrium concentration is approximately one part orthotritium to one part paratritium. The role of an ion mechanism in this conversion is discussed. In the solid phase, the rate of conversion of tritium exceeds that of hydrogen by two orders of magnitude. Author

N64-18139 Joint Publications Research Service, Washington, D.C.
A NEW TYPE OF RADIOACTIVE DECAY
G. Flerov 2 Apr. 1964 8 p Transl. into ENGLISH of an article from Pravda (Moscow), 12 Jan. 1964 p 3
(JPRS-23996; OTS-64-21967) OTS: $0.50

A discussion is presented of radioactive decay of nuclei that is accompanied by emission of protons. It was found that during bombardment of nickel foil by accelerated neon ions two radioactive nuclei are formed. The first nuclei had a half-life of approximately 0.1 sec, and the second had a half-life approximately 250 times longer. The first isotope was found to have an atomic dimension and weight approximately equal to that of the nucleus of neon. The second isotope was found to be located in the periodic system of elements in the region of krypton and selenium. P.V.E.

N64-18144 European Organization for Nuclear Research, Geneva (Switzerland)
RADIOACTIVITY INDUCED IN MATERIALS BY HIGH ENERGY PARTICLES
M. Barbier 11 Jan. 1964 87 p refs
(CERN-64-9)

The radioactivity induced in the materials of high-energy particle-producing installations is being studied to determine the hazard to personnel in the area after the particle-producing equipment is shut down. The physics involved in the emission of gamma rays, ionizing particles, and neutrons from the nuclei of materials struck by high-energy particles is discussed, followed by reports of: (1) the decay of induced radioactivity with time; (2) radiation spectra at various directions and distances from a cyclotron; (3) gamma spectra of iron, copper, and lead samples activated in a cyclotron; (4) activation spectra of various other elements; (5) calculations of activity/gm as a function of flux; (6) absorption of gamma radiation in the active mass; (7) calculation and examples of the field of radiation; (8) estimates of the actual hazards to personnel from different materials; and (9) calculation of the intensity of gamma radiation between the pole pieces of a cyclotron. The results obtained to date permit prediction of the fields of radiation, at least for proton fluxes at cyclotron energies, when the primary fluxes and the geometrical arrangement of the activated elements are known. M.P.G.

N64-18145 European Organization for Nuclear Research, Geneva (Switzerland)
PRODUCTION CROSS-SECTIONS OF TRITIUM AND RARE GASES IN VARIOUS TARGET ELEMENTS
K. Goebel, H. Schultes, and J. Zahringer (Max-Planck-Inst. für Kernphysik) 2 Mar. 1964 81 p refs
(CERN-64-12)

Tritium and rare gas production cross sections for high-energy protons were measured in different materials, including complex materials, such as olivine and stone meteorites, in order to estimate production rates and ratios of these isotopes in meteorites. To find the general behavior of the excitation functions, measurements were made between energies of 0.6 and 25 Gev. The influence on the cross sections due to irradiation technique, monitoring cross sections, and gas separation from the target was studied. Values are given for the cross sections with absolute errors of 15%, and in some cases below 10%. Production ratios were determined from the cross-section measurements, and the final cross-section results have been compared with expected values from Monte Carlo calculations and from Rudstam's spallation formulas. Author

N64-18147 Minnesota U., Minneapolis
UPPER AND LOWER BOUNDS FOR GROUND-STATE SECOND-ORDER PERTURBATION ENERGY
Stephen Prager and Joseph O. Hirschfelder (Wisconsin U.) Repr. from J. Chem. Phys., v. 39, no. 12, 15 Dec. 1963 p 3289–3294 refs
(NASA Grant NsG-275-62(4180))

The first-order perturbation equation, using the Dalgarno-Lewis formulation, is arranged in a form analogous to the Poisson equation for the electrostatic potential produced by a charge distribution in a medium of variable dielectric constant. Thus, the Thomson and Dirichlet variational principles of electrostatics can be used to obtain approximate solutions to the first-order perturbation equation for systems in either the ground state or the lowest energy state of a given symmetry. The Thomson principle provides a useful lower bound to the second-order perturbation energy. The Dirichlet principle is derivable from the Rayleigh–Ritz or Hylleraas principles and gives an upper bound to the second-order energy. For excited states, the Sinanoglu principle provides the upper bound. By optimizing the scaling of the trial perturbed wavefunction, the Hylleraas principle is presented in a somewhat improved form. As an example, the polarizability of atomic hydrogen is used to illustrate both the Thomson and Dirichlet principles and to place upper and lower bounds on the polarizability. Author

N64-18151 European Atomic Energy Community, Brussels (Belgium)
DETERMINATION OF THE DOPPLER EFFECT OF FISSILE ELEMENTS IN FAST REACTORS [DETERMINATION DE L'EFFET DOPPLER DES ELEMENTS FISSILES DANS LES REACTEURS RAPIDES]
A. Ancarani and E. A. Fossoul Jan. 1964 86 p refs In FRENCH; ENGLISH summary Presented at the 8th Nucl. Congr., Rome, 17–23 Jun. 1963
(Contract Euratom-003-61-4-RAPB)
(EUR-530.f) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 125 Belg. Fr.

Systematic studies were carried out on the Doppler effect of fissile elements in energy ranges in which the resonances largely overlap, i.e., beyond about 10 kev. Author

N64-18163* Case Inst. of Tech., Cleveland, Ohio
ANALYSIS OF THE REACTION $B^{11}(d,n)C^{12}_{4.43\ MeV}$
M. A. Nagarajan and A. P. Arya (Toledo U.) Repr. from Nuclear Phys. (Amsterdam), v. 50, 1964 p 61–65 refs
(NASA Grant NsG-345)

Distorted wave analysis of the reaction B^{11} (d,n)C^{12} leading to the 4.43 Mev level of C^{12} has been done for a deuteron energy of 5.35 Mev. The stripping amplitudes so obtained have been used to obtain the neutron-gamma correlation following the decay of the 4.43 Mev state of C^{12}. A comparison is made with the experimental results. Author

N64-18172* Martin Co., Baltimore, Md. RIAS Div.
A DIFFERENTIAL EQUATION FOR UNDAMPED FORCED NON-LINEAR OSCILLATIONS, III
G. R. Morris (Queensland U.) [1963] 53 p refs
(NASA Contract NASw-845; Contract AF 49(638)-1242; Contract Nonr-3693(00))
(NASA CR-53471) OTS: $5.60 ph

A heuristic argument is presented that suggests that if, given the equation $\ddot{x} + g(x) = p(t)$ (Eq.1), where $g(x)/x \to \infty$, Eq.1 has all its solutions bounded and has some periodic solutions when p(t) is periodic; by letting g(x) be $2x^3$, this condition is satisfied, and resulting calculations are simplified as far as possible. If p(t) is even, Eq.1 is unaffected by changing t to $-t$; if p(t) is both even and periodic, simple criteria are obtained for a periodic solution. Adoption of both these specializations leads to the special equation $\ddot{x} + 2x^3 = e(t)$ (Eq.2) where e(t) is written to emphasize the assumed evenness, and it is assumed that e(t) has at least period 2π. It was previously shown that Eq.2 has an infinite class *C* of "large" periodic solutions whose periods are not "too large" compared with their amplitudes. Although these solutions could be described by giving the number of their extrema in a period, they could not be uniquely characterized in this way. This paper shows that a large subclass of *C* can be characterized in this way.
P.V.E.

N64-18174* Illinois U., Urbana
MULTIPLE SCATTERING OF ELECTROMAGNETIC WAVES BY RANDOM SCATTERERS OF FINITE SIZE
N. C. Mathur and K. C. Yeh Dec. 1963 91 p refs
(NASA Grant NsG-24-59)
(NASA CR-53408) OTS: $8.60 ph

The propagation of electromagnetic waves in a random medium is considered, and the treatment is extended to vector electromagnetic waves and scatterers of arbitrary size. The problem is formulated using a self-consistent approach leading to equations that govern the expectation value of the total field and exciting field. These equations are quite general and can be used for scatterers of any shape or size; they are written in terms of the scattering properties of a single isolated scatterer. The problem of scattering by spheres has been considered in detail, using the rigourous Mie theory. In the Born approximation the results show that the distribution of scatterers is equivalent to a modified homogeneous medium in which the refractive index is a function of the size, density, and electromagnetic properties of the spheres. A dispersion relation has been obtained that governs the refractive indices corresponding to modes sustained by the modified medium when multiple scattering effects are taken into account.
C.L.W.

N64-18187 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
STUDY OF ADSORPTION OF GASES ON SOLIDS IN THE HIGH VACUUM RANGE Scientific Report No. 6
C. M. Bliven, J. V. Florio, and T. G. Polanyi 31 Jan. 1964 21 p refs
(Contract AF 19(628)-331)
(AFCRL-64-113; TR-64-255.6; AD-434094)

Adsorption data have been obtained for the tungsten–nitrogen system for a second filament. The lowest surface coverage detectable for which the filament is in quasi-equilibrium with its surrounding is 0.55 of a monolayer. In the study of oxygen adsorption on molybdenum, the carbon monoxide background, resulting from reactions between the incoming oxygen and carbon impurities in the omegatron filament, molybdenum anode, and oxide cathode assembly, has been substantially reduced. The major source of carbon monoxide during oxygen adsorption on the molybdenum anode is replacement of previously adsorbed carbon monoxide by oxygen. Some results on sticking probability and molybdenum work function changes with oxygen coverage are presented.
Author

N64-18190 Aerospace Corp., Patrick AFB, Fla.
PROBABILITY MODEL FOR IMPACTING DEBRIS
J. L. Bagg 6 Mar. 1964 69 p
(Contract AF 04(695)-269)
(TOR-269(A4306)-5; AD-434199)

A procedure is given for determining the expected number of pieces of lethal debris per square nautical mile. An example is completely worked out, and the computer programs used to obtain the results are included. The method is different from the usual approach in that it accounts for varying crossrange dispersion due to the wide range of the aerodynamic characteristics of the debris. This is accomplished by obtaining a probability density function that has a variable angle // to account for the crossrange dispersion.
Author

N64-18201 Argonne National Lab., Ill.
CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, APRIL, MAY, JUNE, 1963
S. Lawroski, R. C. Vogel, Milton Levenson, and V. H. Munnecke [1963] 250 p refs
(Contract W-31-109-ENG-38)
(ANL-6725) OTS: $3.50

Major developmental work on the melt refining process by which EBR-II fuel is purified while in the molten condition has been completed, and work is continuing on related problems. Laboratory-scale studies are being made of the fluid-bed fluoride volatility process by which the uranium and plutonium content of spent oxide fuels will be recovered by fluorination to produce the volatile hexafluorides of uranium and plutonium. Calorimetric determinations have been made for the formation of uranium hexafluoride, uranium monosulfide, tetrafluoromethane, silicon carbide, and hydrogen fluoride gas and its aqueous solutions. Reactor safety studies include investigations of the nature and degree of protectiveness of oxide films, the character of the oxidation reaction, the oxidation and ignition of plutonium, and reaction rates of molten reactor fuel and cladding materials with water. Energy conversion studies of lithium–bismuth cells are continuing. The measurement of neutron cross sections of elements of importance to fast reactor technology has included rhenium-187, gadolinium, and erbium-170.
M.P.G.

N64-18205 European Organization for Nuclear Research, Geneva (Switzerland)
INELASTIC KINEMATICS IN SPACE– MERCURY PROGRAM 1417 P3. DENSITY OF PARTICLES ON A PLANE– MERCURY PROGRAM 1573 P1. [CINEMATIQUE INELASTIQUE DANS L'ESPACE– PROGRAMME "MERCURY" 1417 P3. DENSITE DE PARTICULES SUR UN PLAN– PROGRAMME "MERCURY" 1573 P1]
C. Bonnel 31 Jan. 1964 46 p refs In FRENCH
(CERN-64-8)

Two computer programs, pertinent to inelastic kinematics and the density of particles in a plane, are discussed. One program, the 1417 P3, supplies all of the information required to establish any interaction schema invoking the existence of a short-lived intermediate particle disintegrating directly into two other particles. The second program, the 1573 P1, determines, in the plane of observation, the density of those particles that transverse a given point within this plane. These two programs are sufficiently flexible for use in studying any nuclear reaction involving the creation of an intermediate particle. However, they are far from complete and do not take into account the finite dimensions of the reaction chamber. It is necessary to divide the space of the chamber into a certain number of points, each being the location of an individual reaction. For each of these reactions, there will then be a group of analog results, which can be expressed in the form of a matrix in which each element is one of the densities calculated at point XY. Subsequently an absolute reference system must be defined in the plane O where

all of the elements are transferred. Finally, all of the matrices must be averaged. Thus, it is proposed to transcribe these two programs, united as one, on the IBM-709 computer. I.v.L.

N64-18224 Naval Research Lab., Washington, D.C. Chemistry Div.
A STUDY OF AUTOPHOBIC LIQUIDS ON PLATINUM BY THE CONTACT POTENTIAL METHOD Interim Report
C. O. Timmons and W. A. Zisman 13 Feb. 1964 12 p refs
(NRL-6020; AD-433796)

The liquids studied were n-octanol, n-octanoic acid, tri-p-cresyl phosphite, mixed meta- and para-isomers of tricresyl phosphate, methylene iodide, and three chlorinated biphenyls. Each liquid was shown to be autophobic by the contact potential difference and contact angle data for adsorbed monolayers on platinum. Contact potential differences for the phosphate and phosphite were the same, indicating that the two types of molecules have different mechanisms of surface interaction with the metal surface. It was also found that raising the relative humidity affects the autophobic contact angle of liquid n-octanoic acid, n-octanol, and methylene iodide, but the effect is opposite in sign for the methylene iodide. This result sheds considerable light on the effect of water adsorption on the adsorptive properties of halogen derivatives of the hydrocarbons. Author

N64-18229* Sperry Gyroscope Co., Great Neck, N.Y.
PROPAGATION DELAY FROM WWV
D. W. Proctor *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 56-60 (See N64-18226 10-01)
OTS: $11.00 ph

The raw data from the range-and-range-rate system are related to the time of the measurement at the ground station. These times are synchronized to WWV and include the time delay from WWV to the ground site. Since all computations must be made on the same time basis, propagation-delay corrections from WWV to the site must be included in the computations. Since only three stations are involved, these corrections can be precomputed and stored as program constants for each station location. An equation is derived for computing timing-signal delay from WWV to a range-and-range-rate tracking station. An error analysis is included to illustrate the error magnitudes to be expected in a few typical cases. R.T.K.

N64-18249 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
CRITICAL ANGLE ULTRASONIC TESTS
C. E. Fitch, Jr. and B. W. Chettle 31 Dec. 1963 25 p refs
(Contract AT(45-1)-1350)
(HW-79928)

It has been shown that boundary waves are generated by ultrasound incident at the critical angles on interfaces between acoustically dissimilar media. The presence of these waves, which travel along the interface and have shallow penetration, causes some unusual perturbations in the reflected waves. A reflected beam, for example, suffers a lateral shift along the interface and a redistribution of energy across the beam. These effects have been demonstrated and used to measure Zircaloy-2 surface hydride in amounts as small as 300 ppm. Compressive surface strains of about 300 μin./in. in brass and 300 to 500 μin./in. in aluminum were also detected. A maximum strain of about 500 μin./in. in stainless steel did not produce a measurable effect. Boundary wave generation was shown to exist also for solid–solid interfaces. Author

N64-18250 Aerospace Corp., El Segundo, Calif.
INFRARED – TODAY AND TOMORROW
Irving J. Spiro 4 Mar. 1964 26 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-238; TDR-269(4526-10)-1; AD-434358)

The nature of infrared radiation and its transmission through the atmospheric constituents up to the entrance window of an optical system are described. The current state-of-the-art of infrared technology, both civilian and military, is outlined, and some future improvements and developments are predicted on a basis of extrapolations of present equipment and component capabilities. Author

N64-18266 Cambridge Acoustical Associates, Inc., Mass.
A VARIATIONAL SOLUTION OF SOLID AND FREE-FLOODING CYLINDRICAL SOUND RADIATORS OF FINITE LENGTH
Miguel C. Junger 1 Mar. 1964 54 p refs
(Contract Nonr-2739(00))
(U-177-48; AD-432664)

The radiation impedance of a cylindrical sound source of finite length can be expressed as the sum of two components: $Z = Z_r + Z_\alpha$, where Z_r is the impedance evaluated by means of the generally used technique originated by Robey, which assumes that the radiating surface is bracketed between two rigid semi-infinite cylindrical baffles. Z_α is associated with the radial velocity distribution $\alpha(z)$ over these two semi-infinite cylindrical surfaces and is therefore in the nature of a correction factor to Robey's impedance. Variational solutions are presented for solid and free-flooding cylinders for axisymmetric and for arbitrary velocity distributions. A variational solution is given for "squirters" of finite wall thickness, but it is restricted to thin-walled transducers. In an appendix, nonvariational solutions of the integral equation for $\alpha(z)$ are presented for "squirters" of greater wall thickness. Author

N64-18267 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
VIBRATIONAL EXCITATION OF N_2, CO, AND H_2 BY ELECTRON IMPACT
A. V. Phelps and G. J. Schulz [1963] 30 p refs
(Contract Nonr-2584(00); ARPA Order 125-63 (Amd. 10); Proj. DEFENDER)
(Rept. 22; AD-433190)

The present experiment was undertaken in order to provide further evidence for the vibrational cross-section behavior in nitrogen and to extend the experimental technique to two other molecules. The cross section for vibrational excitation of N_2, CO, and H_2 by electron impact is measured using a double electrostatic analyzer. Electrons are examined after scattering from the molecules at an angle of 72°. Both N_2 and CO exhibit a small vibrational cross section to the first state below 1.7 ev and 1.0 ev, respectively, which is attributed to direct excitation by electron impact. Above these energies, many vibrational states are excited, and the cross section becomes large; it is postulated that the excitation proceeds via a compound state of N_2 and CO. The peak of the cross section occurs at 2.3 ev in N_2 and at 1.75 ev in CO. In hydrogen, the cross section to the first vibrational state predominates; the cross section to the second vibrational state of H_2 is about 14% of the first state, at an energy of 3.4 ev. R.T.K.

N64-18271 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
ELECTRIC-POTENTIAL TECHNIQUE FOR DETERMINING SLOW CRACK GROWTH

Albert A. Anctil, Eric B. Kula, and Eugene Di Cesare Dec. 1963 16 p refs
(AMRA-TR-63-27; AD-432497) OTS: $0.50

Slow crack growth was followed as a function of applied load during fracture toughness testing of high-strength sheet materials by continuous measurement of electric-potential field changes across the crack. The instrument employed is a milliohmmeter using the ammeter–voltmeter measurement method with a minimum of current passing through the test specimen. Voltage drop across the crack, rather than resistance, is measured. Electronic and mechanical testing techniques are described. Typical potential field distribution diagrams illustrate the potential change with crack growth. A single calibration curve for crack size versus potential drop may be obtained independent of material and specimen configuration by maintaining geometrical similarity of current and potential contacts. Calibration data are readily obtainable for any specimen design by duplicating the specimen in aluminum foil and simulating crack growth with a razor. Author

N64-18279* General Dynamics Corp., San Diego, Calif. General Atomic Div.
CALCULATION OF SLOW NEUTRON SCATTERING CROSS-SECTIONS OF MOLECULAR HYDROGEN AND DEUTERIUM
Topical Report
James A. Young and Juan U. Koppel 20 Dec. 1963 45 p refs Submitted for Publication
(NASA Contract NAS3-4214)
(NASA CR-54001; GA-4828) OTS: $4.60 ph

The cross sections for neutrons scattering from H_2 and D_2 have been calculated taking into account the spin correlations, rotations, and vibrations of the molecules exactly, to the extent that the vibrations are harmonic and do not interact with the rotations. Free translations of the molecules are assumed, but this assumption is expected to be valid in the liquid for neutron energies above 0.002 ev. Numerical results are given for the total cross section for both orthohydrogen and parahydrogen gas at 20.4° K that agree reasonably well with the limited experimental results available. Also curves of the double differential cross section are shown for selected incident neutron energies and scattering angles. These latter curves show very clearly the various rotational and vibrational transitions. The formulas given here are applicable at all temperatures below the thermal excitation of the first vibrational level. Author

N64-18291* Virginia U., Charlottesville
STATUS REPORT NO. 1, Jun.-30 Nov. 1963 [THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF PARTICLE DETECTION AND PARTICLE DETECTORS TO IMPROVE EFFECTIVENESS, ACCURACY AND DISCRIMINATION]
K. Ziock and R. C. Ritter [1963] 4 p refs
(NASA Grant NsG-455)
(NASA CR-53389) OTS: $1.10 ph

An investigation is conducted of a method for increasing the active volume of lithium-drifted germanium semiconductor detectors. This method involves a combination of lithium-drifting and special geometrical configurations. C.L.W.

N64-18304* Pennsylvania U., Philadelphia Inst. for Direct Energy Conversion
STATUS REPORT AS OF JANUARY, 1964
28 Feb. 1964 106 p refs
(NASA Grant NsG-316)
(NASA CR-53557) OTS: $9.10 ph

The current program status includes: (1) Microbiological and electrochemical aspects of the system formic acid–formic dehydrogenlyase were studied. Optimal enzyme and substrate concentrations were determined, and a slow deactivation of the enzyme system (over a period of 6 hours) was observed. The electrochemically active substance was shown to be the hydrogen molecule hydrogen produced by the enzyme catalyzed splitting of the formic acid substrate. A power density of 2 to 3 mW/cc can be maintained by this system at low current densities over 4 to 6 hours. (2) A program has been initiated, which will use a potassium-seeded argon plasma, to obtain a quantitative understanding of the phenomenon of nonequilibrium ionization and to augment "industrial" investigations that are concerned with "bulk" or average effects, with detail measurements of local electron and ion temperature. (3) A large number of theoretical models has been analyzed in order to describe the operation of, and obtain the criteria for, a parallel-plane plasma thermocouple. (4) A successful "model" has been developed for the analysis of plasma thermionic converters in the "passive" mode. (5) Studies concerned with solar reflectors–heat receivers have shown that Lambert's law leads to flux distributions inside a cavity that are significantly different from the correct ones. I.v.L.

N64-18307 Pittsburgh U., Pa.
MEASUREMENTS OF CHARGE TRANSFER AND IONIZATION CROSS SECTIONS
James F. Nolan Dec. 1963 63 p refs
(Contract Nonr-624(06))
(Rept. 18; AD-430105) OTS: $6.60

Slow ions produced by charge transfer and by ionization collisions rather than by collection on a pair of collecting electrodes are observed in a mass spectrometer. As a result it is possible to distinguish between the individual processes that contribute to the total charge transfer and total ionization cross sections. The cross sections for production of H_2^+, H^+, and H^- ions with a proton beam incident on H_2 are presented. These cross sections depend on two assumptions concerning the collection efficiency of the mass spectrometer. The relative cross section as a function of energy for each ion depends on the assumption that the collection efficiency for a given ion does not change as the beam energy is varied. The absolute values depend on the further assumption that the collection efficiency is the same for different species of ion. R.T.K.

N64-18339 Princeton U., N.J. Plasma Physics Lab.
ON THERMODYNAMIC EQUILIBRIUM IN A GRAVITATIONAL FIELD
N. L. Balazs and J. M. Dawson Nov. 1963 24 p refs
(Contract AT(30-1)-1238)
(MATT-221)

Thermal equilibrium in a gravitational field is examined by using the standard tools of thermodynamics, and by including the relativistic effects associated with the mass energy relation. It is found that an appropriately defined temperature is not constant at equilibrium but decreases with increasing gravitational potential. The gravitational red shift is a simple manifestation of this. In terms of this temperature the local thermodynamic properties are independent of the gravitational potential. It is also found possible to define another temperature that is uniform at equilibrium. However, use of this temperature requires that the thermodynamic properties (for example, melting points) be explicit functions of the gravitational potential. Author

N64-18350* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
MEASURED AND CALCULATED NUCLEAR RADIATION DISTRIBUTIONS IN LIQUID HYDROGEN
W. A. Hehs and G. E. Miller 27 Mar. 1964 44 p refs
(NASA Contract NAS3-3324)
(NASA CR-54003; FZK-182) OTS: $4.60 ph

The nuclear radiation measurements and calculations obtained from a series of experiments designed to investigate the effects of nuclear heating in liquid hydrogen are reported. The experimental arrangement simulated the radiation source and liquid-hydrogen propellant-tank geometry of a typical nuclear rocket system. The operating capacity of the tank was approximately 125 gallons. Nuclear radiation measurements were made in and around the liquid-hydrogen tank with the tank both empty and full of hydrogen. The radiation detectors and techniques used in making these measurements are described, and the measurements are compared with calculated nuclear radiation intensities. The calculations include secondary-gamma-ray production in the liquid hydrogen and in surrounding materials. Assumptions and methods utilized in performing these calculations are discussed. Author

N64-18367 Army Signal Research and Development Labs., Fort Monmouth, N.J.
THE DESIGN AND USE OF DIFFUSION FILL DEVICES IN ULTRA-HIGH VACUUM APPLICATIONS
Rudolf G. Buser and John J. Sullivan Feb. 1964 24 p refs
(USAELRDL-TR-2420; AD-434746)

The properties (influx rate, purification factor, intrinsic gas load, and switching times) of a helium fill device and its application in ultra-high vacuum work are discussed in detail. Several limitations and their remedies are considered, and experimental results are given. Author

N64-18385 Library of Congress, Washington, D.C. Aerospace Information Div.
PHOTOIONIZATION IN GASES. COMPREHENSIVE REPORT ON SOVIET PERIODICAL LITERATURE, DECEMBER 1952-SEPTEMBER 1963
6 Mar. 1964 77 p refs
(AID-P-64-12; AD-434295) OTS: $7.60 ph

A summary is presented of Soviet research on photoionization. The papers discussed deal with the calculation of atomic cross sections for photoionization. The summary is divided into two sections: (1) theoretical research on photoionization; and (2) experimental research on photoionization (organic compounds only). P.V.E.

N64-18387 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
MODAL ANALYSIS AND SYNTHESIS OF ELECTROMAGNETIC FIELDS
L. B. Felsen and N. Marcuvitz 18 Dec. 1963 81 p refs
(Contract AF 19(604)-7499)
(PIBMRI-1124-63; AFCRL-64-39; AD-433166)

The effect on electromagnetic radiation introduced by anisotropy in the surrounding medium is discussed. The simplest type of anisotropy, the uniaxial, whose constitutive parameters may be described in an appropriate coordinate system by a diagonal tensor, having two of its three nonvanishing elements equal, is considered. Physical media that may be represented in this manner include uniaxial crystals and plasmas or ferrites under the influence of an infinitely strong, external magnetic field. The formulation and solution of radiation and diffraction problems in uniaxial regions and the physical interpretation of the results are presented. R.T.K.

N64-18395 Iowa State U. of Science and Tech., Ames. Ames Lab.
PHOTONEUTRON RESONANCES IN OXYGEN 16
James Edward Griffin and Charles L. Hammer Feb. 1963 106 p refs. Based on a Ph.D. Thesis by James Edward Griffin
(Contract W-4705-ENG-82)
(IS-676) OTS: $2.25

The cross section for the reaction $O^{16}(\gamma,n)O^{15}$ has been determined from threshold energy to 60 Mev using bremsstrahlung from the Iowa State University synchrotron. The O^{15} radioactivity yield curve was measured and the relative cross section extracted using least-structure analysis. The data were corrected for multiple neutron processes and extraneous activities. No angular distribution studies were made and no experimental multipolarities assigned. The problem of cross-section extraction from a yield curve is described and the resulting integral equation is presented in matrix form. Several methods of solution are discussed, and the least structure method is described in detail. Resonances in the $O^{16}(\gamma,n)O^{15}$ cross section are observed at 17.4, 19.3, 22.4, 24.5, 32.7, 38.9, 45.1, 50.4, and 57.9 Mev, with additional poorly resolved resonances at 21.0, 26.5, and 28.4 Mev. Author

N64-18396 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Feb. 1964 67 p refs
(Contract W-7405-ENG-92)
(BMI-1661 (Del.)) OTS: $1.50

Activities in the following areas are discussed: (1) reactor materials and components—irradiation-surveillance program on and mechanical properties of irradiated type-347 stainless steel, fabrication of projections on zircaloy tubes; (2) fuel studies—fission-product release from refractory fuels, carbon diffusion in UC, U_2C_3, and UC_2; (3) fuel-element development—fabrication of cermet fuel elements; (4) radioisotope and radiation applications—development of high-dielectric-constant, low-dielectric-loss polymers utilizing gamma irradiation; (5) development of a tracer system for in-place filter evaluation; (6) coated-particle fuel materials—graphite-matrix and fission-product-diffusion studies; (7) corrosion studies of the fluoride-volatility process; (8) long-term creep-rupture program on SAP alloys and mechanical properties of zirconium alloys; (9) gas-cooled reactor program—UO_2-ZrO_2 and encapsulation studies; and (10) joining of regenerative cell components. P.V.E.

N64-18405 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR OCTOBER, 1963
J. F. Eichelberger, G. R. Grove, and L. V. Jones 31 Oct. 1963 29 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1177)

Research activities in the following areas are summarized: (1) flexible, conductive polysulfide-epoxy adhesive development; (2) radioelements research—promethium separation and purification, half-life of polonium-208 and polonium-209, uranium-234 separation and purification, half-life of plutonium-238, potassium plutonium sulfate dihydrate; (3) isotope separation—measurement of carbon monoxide transport coefficients, carbon monoxide distillation, xenon (thermal diffusion and experimental chromatography), trennschaukel (swing separator) development, calculation of collision integrals, low-temperature thermal diffusion factor; (4) neutron and alpha sources; and (5) low-level tritium counting. P.V.E.

N64-18406 Mound Lab., Miamisburg, Ohio
MOUND LABORATORY PROGRESS REPORT FOR DECEMBER, 1963

J. F. Eichelberger, G. R. Grove, and L. V. Jones 31 Dec. 1963 41 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1179)

The following are discussed: (1) adhesives and plastics research—preparations of two polysulfide-based conductive adhesives, and evaluation of zirconia fibers as a filler for diallyl phthalate molding powders; (2) radio-elements research—polonium-209 half-life, polonium decay-scheme studies, determination of coincidence correction, half-life of radium-233, and residue adsorption; (3) isotope separation—helium-3, equation of continuity for the cylindrical case, carbon-13, neon, and krypton; (4) alpha- and neutron-source development; (5) calorimetry; and (6) gamma activation analysis of beryllium. R.T.K.

N64-18407 European Atomic Energy Community, Brussels (Belgium)
HIGH PRECISION $4\pi\beta$-γ-COINCIDENCE COUNTING AND THE PREPARATION OF SOLID Co^{60} STANDARD SOURCES AND SOLUTIONS FOR AN INTERNATIONAL COMPARISON
A. Spernol, E. De Roost, and O. Lerch Joint Nucl. Res. Center, Geel Estab. (Belgium), Feb. 1964 31 p refs
(EUR-477.e) Available from Belgian American Bank and Trust Co., N.Y. Account No. 121.86: 50 Belg. Fr.

The preparation and properties of electrolytically deposited Co^{60} sources and Co^{60} standard solutions are described. The $4\pi\beta$-γ-coincidence method used for the determination of their activities is discussed in detail, with particular reference to the corrections that have to be applied to the measured results and their control. Author

N64-18416* National Bureau of Standards, Washington, D.C.
ENERGY SPECTRA AND ANGULAR DISTRIBUTIONS OF ELECTRONS TRANSMITTED THROUGH SAPPHIRE (Al_2O_3) FOILS
Martin J. Berger and Stephen M. Seltzer Wash., D.C., NASA, 1964 109 p refs
(NASA Order R-80)
(NASA SP-3008)

Monte Carlo results are presented, in the form of 72 tables, pertaining to the transmission of electrons incident with energies of 1, 2, 2.954, 4, 5.907, and 8 Mev on sapphire foils with thicknesses of 0.1, 0.2, and 0.3 g/cm^2. Two types of beam geometry are treated for all source energies—perpendicular incidence and beams with an initial cosine-law angular distribution (corresponding to an isotropic electron flux). For a source energy of 2 Mev, various incident beam obliquities are also treated, ranging from grazing to perpendicular incidence. The physical factors taken into account include the energy losses due to collisions with atomic electrons (mean value and fluctuations), the mean energy loss due to bremsstrahlung, and the angular deflections and path detours due to multiple Coulomb scattering by atoms. Author

N64-18422* Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
OPTICAL SYSTEMS STUDY Monthly Progress Report No. 10, 20 Feb.-20 Mar. 1964
30 Mar. 1964 6 p
(NASA Contract NASw-703)
(NASA CR-53564) OTS: $1.10 ph

The mercury-cell modulation transfer-scheme experiment was completed. Some of the experimental results are included for comparison with theory. Empirical and theoretical equations that describe the response of the cell are in close agreement. R.T.K.

N64-18423* Stevens Inst. of Tech., Hoboken, N.J.
PRINCIPLES OF GENERAL COVARIANCE AND THE ROLE OF COORDINATES IN GENERAL RELATIVITY Semi-Annual Report, 1 Jan.-Jul. 1963
James L. Anderson 1 Jul. 1963 8 p refs
(NASA Grant NsG-326)
(NASA CR-53563; SIT-P107 (11/63) OTS: $1.10 ph

Developments in the investigation of various aspects of the principle of general covariance, both in classical and quantum physics, are summarized. A paper dealing, in particular, with "Q-number Coordinate Transformations and the Ordering Problem in General Relativity" is included. P.V.E.

N64-18426* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPIN PROPERTIES OF PAIR-CORRELATED ATOMIC AND MOLECULAR SINGLET WAVEFUNCTIONS
Howard B. Levine (N. Am. Aviation Sci. Center), Murray Geller, and Howard S. Taylor Repr. from J. Chem. Phys., v. 40, no. 2, 15 Jan. 1964 p 595-602 refs
(NASA Contract NAS7-100)
(NASA CR-53565; JPL-TR-32-565)

The recent work of Sinanoğlu upon pair-correlated wavefunctions is considered. The conditions required for his wavefunction to be a spin singlet are derived, and these conditions related to his theory. In particular, they are shown to be satisfied to an approximation consistent with those used in deriving his "exact pair" theory. An error in the original integral breakdown is also pointed out and shown to have little effect on the results of the theory. Author

N64-18427* Oak Ridge National Lab., Tenn. Neutron Physics Div.
MEASUREMENT OF THE INTENSITY OF THE PROTON BEAM OF THE HARVARD UNIVERSITY SYNCHROCYCLOTRON FOR ENERGY-SPECTRAL MEASUREMENTS OF NUCLEAR SECONDARIES
R. T. Santoro and R. W. Peelle Mar. 1964 56 p refs
(NASA Order T-7632; NASA Order R-104; Contract W-7405-ENG-26)
(NASA CR-53566; ORNL-3505) OTS: $5.60 ph

Two thin helium-filled parallel-plate ionization chambers were designed for use in continuously monitoring the 160-Mev proton beam of the Harvard University Synchrocyclotron over an intensity range from 10^5 to 10^{10} protons/sec. The ionization chambers were calibrated by two independent methods. In four calibrations, the charge collected in the ionization chambers was compared with that deposited in a Faraday cup that followed the ionization chambers in the proton beam. In a second method, a calibration was made by individually counting beam protons with a pair of thin scintillation detectors. The ionization chamber response was found to be flat within 2% for a five-decade range of beam intensity. A slow shift in the calibrations with time is ascribed to a gradual contamination of the helium of the chambers by air leakage. An appendix describes the calibration of standard current sources used for accurate calibration of the current-measuring instruments. Author

N64-18444* Westinghouse Electric Corp., Baltimore, Md. Air Arm Div.
DEVELOPMENT OF AN IMAGE CONVERTER OF RADICAL DESIGN (PHASE II) Monthly Progress Report No. 15, 1 Sep.-30 Sep. 1963
3 Oct. 1963 17 p ref
(NASA Contract NAS8-5112)
(NASA CR-53579) OTS: $1.60 ph

The results of attempts to develop and fabricate a 50 × 50 element phototransistor mosaic, and to design peripheral equipment to permit readout of the mosaic output signals are presented. Efforts to establish the causes and remedies of difficulties experienced in the photosensor mosaic development and to establish a more optimum sensor structure are also reported. R.T.K.

N64-18446* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Space Sciences Div.
INFRARED ABSORPTION OF THE ν_3 FUNDAMENTAL OF LIQUID AND SOLID CH_4 AND CD_4
George E. Ewing. Repr. from J. Chem. Phys., v. 40, no. 1, 1 Jan. 1964 p 179–183 refs
(NASA Contract NAS7-100)
(NASA CR-53569; JPL-TR-32-551)

The ν_2 fundamental of CH_4, CD_4, and solutions of CD_4 in CH_4 has been studied in the liquid and solid state from 105° to 28° K. The broad liquid-state absorption approximates the gas-phase vibration–rotation envelope in the wings, but has significantly more absorption at the band center. This deviation is consistent with the assumption that molecules in the liquid can undergo hindered rotation. The bandwidth decreases gradually with temperature but undergoes no discernible discontinuous change on passing through the freezing point, which suggests that rotatory motion persists in this solid phase. The bandwidth of the fundamental of liquid and solid CD_4 is narrower than CH_4 but behaves in a similar fashion with temperature. The band shape and position of ν_3 of CD_4 in solution with CH_4 is indistinguishable from that of pure liquid CD_4. In the solid state, however, the ν_3 bandwidth of CD_4 in the CD_4–CH_4 solution is slightly larger than the ν_3 bandwidth of pure CD_4. Author

N64-18448* Martin Co., Baltimore, Md. RIAS Div.
ON THE PARAMETRIZATION OF THE THREE-DIMENSIONAL ROTATION GROUP
John Stuelpnagel. [1948] 16 p refs
(NASA Contract NASw-845; Contract AF 49(638)-1242; Contract Nonr-3693(00))
(NASA CR-53568) OTS: $1.60 ph

A mathematical demonstration is presented of why it is topologically impossible to have a global 3-dimensional parametrization without singular points for the rotation group. This is a topological fact, and is a special case of a corollary to Brouwer's theorem on the invariance of domain. It is also shown that, although Hopf demonstrated in 1940 that five is the minimum number of parameters that suffices to represent the rotation group in a 1-1 global manner, the so-called "quaternion method" of parametrizing the group in a 1-2 way, using 4 parameters, is sufficient for practical purposes. In addition, three 3-dimensional parametrizations, as well as Hopf's method of using 5 parameters, are examined. R.T.K.

N64-18455* Alabama U. Research Inst., Huntsville
THE MATHEMATICAL ANALYSIS OF LATTICE BOUNDARY VALUE PROBLEMS APPLIED TO MOLECULAR COLLISIONS WITH SURFACES
C. M. Chambers, Jr. and E. T. Kinzer, Jr. Feb. 1964 52 p refs
(NASA Grant NsG-381)
(NASA CR-53577; UARI-RR-9) OTS: $5.60 ph

The previously initiated study of the model for particle–surface collisions proposed by Kinzer and Chambers was completed. This included the calculation and analysis of the frequency spectrum excited in the solid and the calculation of thermal accommodation coefficients in the high-velocity limiting case. The equations of motion for the problem of the collision of a diatomic molecule with a crystal lattice in the one-dimensional approximation were solved, and the high-velocity thermal accommodation coefficients were calculated and compared with the equivalent results for the monatomic collision problem. Finally, the mathematical techniques necessary for the treatment of boundary-value problems involving repetitive structures, such as crystal lattices, were developed and applied to a variety of structures, including simple three-dimensional lattices. Author

N64-18461 Atomic Energy of Canada Ltd., Chalk River, Ontario
FISSION RESONANCE INTEGRALS OF U-233, U-235, PU-239 AND PU-241
C. B. Bigham. Feb. 1964 27 p refs
(AECL-1910; CRRP-1183)

The fission resonance integrals of U-233, U-235, Pu-239, and Pu-241 have been measured relative to boron, lithium, and gold standards by fission counting. The fission resonance integrals of U-233, U-235, and Pu-239 were also measured relative to an indium standard by the fission product γ-counting technique. Weighted averages of the fission resonance integrals above a 0.45 ev cut-off (including the 1/v contribution) obtained from this and other measurements are 761 ±17 barns for U-233, 277 ±5 barns for U-235, 324 ±9 barns for Pu-239, and 541 ±14 barns for Pu-241. Author

N64-18481 Industrial Science and Technology Agency, Tokyo (Japan). Electrotechnical Lab.
TIME-RESOLVING PHOTOMETRY
Naoshi Takemura. Jun. 1963 86 p refs ENGLISH summary
(*Its* Circular 154)

This paper includes the following: (1) history of the time resolution of light intensity; (2) construction of spectrometer for the study of plasma; (3) on the time resolution of spectral line broadening; and (4) photographic and photoelectric spectrometry. Author

N64-18489* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A BLAST-WAVE THEORY OF CRATER FORMATION IN SEMI-INFINITE TARGETS
William J. Rae and Henry P. Kirchner. *In* Firestone Tire and Rubber Co. Proc. of the 6th Symp. on Hypervelocity Impact, Cleveland, Apr. 30–May 2, 1963, Vol. 2, Pt. 1 Aug. 1963 p 163–227 refs (See N64-13521 05-23)
(NASA Contract NAS3-2121)
(NASA CR-52427)

An analytic formulation of the problem of crater formation is presented, using the methods of blast-wave theory. The approximations on which this approach is based are chiefly concerned with the self-similar, or progressing-wave nature of the solution, with the type of state equation used, and with the extent to which the conservation of energy and momentum can be fulfilled. These approximations and the limitations that they impose are reviewed, particularly as applied to the problem of shock propagation in solids. An approximate nonsimilar solution for impact-generated shock propagation is derived and displays excellent agreement with observed shock-wave trajectories. To derive a penetration law from any solution, some point in the trajectory must be chosen as the crater radius. A simple choice of the crater-formation criterion, related to the intrinsic shear strength of the target, is utilized in conjunction with the nonsimilar solution, to derive a penetration law that correlates a large amount of data. Author

N64-18483 U. (Belgium)
THE INFRARED SPECTRA OF STARS (REGION: 1μ TO 3 mm) [LES SPECTRES INFRAROUGES DES ASTRES (REGION: 1μ A 3 mm)]
[1963] 24 p In ENGLISH; Partially in FRENCH Summary of speeches presented at Twelfth Intern. Conf. of Astrophys., 24–26 Jun. 1963

Summaries are presented of speeches given at the Twelfth International Conference of Astrophysicists. The speeches are divided under the following major headings: (1) spectroscopic investigations of astronomical interest; (2) recent developments in infrared technics; (3) the solar spectrum; (4) the telluric absorption spectrum; (5) the telluric emission spectrum; and (6) planets, comets, and cold stars. P.V.E.

N64-18491 Los Alamos Scientific Lab., N. Mex.
A SEARCH FOR THE MOSSBAUER RESONANCE OF THE 137 keV γ RAY OF Fe^{57}
T. A. Kitchens, W. A. Steyert, and R. D. Taylor 1 Apr. 1964 16 p refs
(Contract W-7405-ENG-36)
(LAMS-3053) OTS: $0.50

An attempt has been made to observe the Mössbauer absorption and reemission of the γ-ray associated with the 137 kev, 8 nanosecond level in Fe^{57}. The geometry employed is shown to be very sensitive to small resonances, the background is quantitatively explained, and the Mössbauer recoil-free fraction is shown to be no larger than that predicted by the Debye theory. Author

N64-18493* Western Ontario U., London (Canada)
ELECTRONIC TRANSITION MOMENTS AND THEIR EFFECTS ON THE BAND STRENGTHS AND ABSORPTION OSCILLATOR STRENGTHS OF THE NO β AND γ SYSTEMS
G. V. Marr (Reading U.) Repr. from Proc. Phys. Soc. (London), v. 83, 1964 p 293–300 refs
(NASA Grant NsG-349; AF AFOSR Grant 62-236; Contract DRB MM 69-300002)

The variation of the electronic transition moment with internuclear separation for the $NO\beta(B^2\Pi - X^2\Pi)$ and $NO\gamma(A^2\Sigma^+ - X^2\Pi)$ systems, inferred from available intensity measurements, is used to evaluate band strengths and band absorption oscillator strengths. It is doubtful whether the concept of an electronic oscillator strength for the whole system is meaningful for these transitions. Author

N64-18494* Western Ontario U., London (Canada)
THE ELECTRONIC TRANSITION MOMENT FOR THE SCHUMANN-RUNGE BAND SYSTEM OF O_2
G. V. Marr (Reading U.) Repr. from Can. J. Phys., v. 42, no. 382, Feb. 1964 p 382–386 refs
(NASA Grant NsG-349)

This report evaluates the available experimental intensity data for the various parts of the band system. Estimates are made from these data of the variation of the electronic transition moment of the $B^3\Sigma_u^- - X^3\Sigma_g^-$ transition with internuclear separation of the oxygen atoms. I.v.L.

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-17853 Aberdeen Proving Ground, Md. Ballistic Research Labs.
INTERFEROMETRIC ANALYSIS OF AXISYMMETRIC PLASMA FLOW
G. D. Kahl and E. H. Wedemeyer Sep. 1963 23 p refs
(BRL-1222; AD-427767)

Experimental results of applying the method of two wavelength, streak interferometry are given for the cylindrical, time-dependent flow of ionized argon produced by an exploding wire. Measurements from simultaneous streak interferograms at wavelengths 5,460 A and 4,358 A are used to determine contour charts of electron concentration and mass density of the shock-arc-heated argon plasma. Where thermal equilibrium can be assumed, values of velocity, pressure, and temperature can be deduced. The resulting temperatures agree well with those obtained from the Saha relation at the measured degree of ionization. The reduction equations and assumptions needed for the axisymmetric analysis are given. An estimate is made of the error in measured mass density caused by multiple ionization. Author

N64-17896 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
ENERGY TRANSFER PROCESSES IN A PARTIALLY IONIZED, TWO-TEMPERATURE GAS
Donald M. Dix 2 Mar. 1964 64 p refs
(ATN-64(9232)-1; AD-433007) OTS: $6.60

The elementary situation of convective energy transfer between parallel plates at different temperatures is analyzed for partially ionized, nonreacting, monatomic hydrogen wherein the electrons may be at a temperature different from that of the heavier species. The gas conditions considered are such that an ion sheath, less than a mean free path in spatial extent, forms on the fully catalytic colder surface. The numerical results obtained indicate that: (1) the gross features of the continuum solution are rather insensitive to the models of sheath and transition regions employed; (2) the energy transfer between ions and electrons due to the electric field external to the sheath is appreciable; (3) thermal nonequilibrium effects on total heat transfer are not as great as might be anticipated, due to energy transfer between species by electric fields and the contribution of diffusional processes; (4) magnetic field effects on total heat transfer are less than the effect on electronic thermal conductivity would indicate and are lessened further by thermal nonequilibrium effects. Author

N64-17900 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
MHD WIND TUNNEL PROGRAM [Quarterly Status Report] 1 Oct.–31 Dec. 1963
D. A. Durran, W. R. Grabowsky, and D. J. Spencer 21 Feb. 1964 23 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-11; TDR-269(4230-10)-7; AD-433089)

A pulsed-type experimental facility is being assembled to study the feasibility of a hypervelocity wind tunnel employing an MHD accelerator. This report presents a description of the hot shot that will be used as a source for the MHD accelerator. The present status of the experimental work concerned with the accelerator is given. Author

N64-17903 Massachusetts Inst. of Tech., Cambridge Research Inst. of Tech.
EXPERIMENTAL STUDY OF INDUCTION-COUPLED LIQUID-METAL MAGNETOHYDRODYNAMIC CHANNEL FLOW

W. D. Jackson and R. P. Porter *In its* Res. on New Concepts in Energy Conversion [1963] p 12–18 refs (See N64-17901 10-23)

An induction-coupled liquid-metal MHD channel flow is discussed. Eutectic sodium potassium alloy (NaK) was selected as the working fluid for a closed-loop flow facility driven by a positive displacement pump with a capacity of 20 gpm at a head of 20 psi. Measurements were made of fluid velocity, pressure drop along the MHD channel section, and power flow between the alternator and the coil system. I.v.L.

N64-18005 Nagoya U. (Japan) Inst. of Plasma Physics
RF CURRENT COMPONENT IN THE RESONANCE PROBE
J. Uramoto, J. Fujita, H. Ikegami, and K. Takayama Dec. 1963 16 p refs
(IPPJ-19)

The resonance probe is investigated in a quiescent low-density plasma in a mercury vapor discharge. A quiescent plasma is produced by back-diffusion-type mercury discharges. The emphasis is on the comparison between the RF component and the d.c. component of the current to the probe. It is shown that the RF component has its maximum at the same frequency at which the d.c. current component shows a resonance peak. The resonance in the d.c. current was believed to appear at the electron plasma frequency. However, the present experimental results suggest that the resonance in the d.c. or RF current may not be at the electron plasma frequency. The real electron plasma frequency may be close to the frequency at which the RF current shows its minimum. Author

N64-18010 AeroChem Research Labs., Inc., Princeton, N.J.
THE EFFECTS OF MAGNETIC FIELDS ON A FLOWING PLASMA Final Report, Jun. 1959–Nov. 1962
S. A. Gordon Jan. 1963 31 p refs
(Contract AF 33(616)-6717)
(AeroChem-TP-56; AD-434097)

An overall review is made of the work undertaken to measure heat-transfer rates in a flowing plasma. It is pointed out that the lack of reliable measurement techniques (in itself due to the immature state of plasma research) has impeded progress. The current status of these investigations is that a measurable decrease in heat transfer to the stagnation point has been obtained. A further anomalous dependence of the size of the reduction on magnetic field direction has not yet been fully settled. Author

N64-18036 Air Force Systems Command, Wright-Patterson AFB, Ohio. Aeronautical Systems Div.
LIQUID METAL MAGNETOHYDRODYNAMIC POWER CONVERSION
Gene B. Stafford Sep. 1963 30 p refs Presented at the ASD 1963 Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, 18–19 Sep. 1963
(ASD-TDR-63-700; AD-433235)

The basic operating characteristics of a straight channel, conduction, liquid metal magnetohydrodynamic (MHD) generator are presented. The ideal case is presented, and then the various losses that might occur are introduced along with means of compensating for them. Two systems are shown that can utilize a liquid metal MHD generator. Criteria for the selection of the working fluids are shown, and possible candidate working fluids are presented. Author

N64-18072 Naval Research Lab., Washington, D.C.
OPEN METAL-CORED CARBON ARC AS A PLASMA GENERATOR
W. W. Balwanz *In its* Rept. of NRL Progr., Jan. 1964 p 16–23 refs (See N64-18070 10-23) OTS: $1.25

The open metal-cored, carbon-arc, plasma generator produces a small, intense, spatially unstable plasma that does not spread appreciably at ambient pressures of 8 mm Hg and 0.7 mm Hg. Electron densities exceeded 10^{13}/cc (the limits of measurement with the instrumentation used) at both pressures at a distance of 3 in. from the generator tip. The measured plasma length did not exceed 8.5 in. with the use of aluminum cores (10 runs) or 15 in. (one run) with a zinc core. Author

N64-18143 Nagoya U., (Japan) Inst. of Plasma Physics
DAMPING OF PHONONS IN AN ELECTRON-ION GAS
Toshiyuki Nishiyama (Osaka U.) Dec. 1963 13 p refs
(IPPJ-18)

Relaxation time and phonon mean free path have been obtained for an electron–gas (a quantum plasma) from the expression for the angle of dielectric loss. The familiar formula for the dielectric constant has been extended so as to include the lifetime effect of electronic levels. In this way a quantum mechanical version of Pippard's semiclassical theory for the phonon mean free path has been shown in a simple but convincing manner. The result can be applied to liquid metals and classical plasmas. The problem at finite temperatures is also considered. As another application, the polarizability in the presence of a static magnetic field is obtained. Author

N64-18156 Aeronautical Research Council (Gt. Brit.)
DISCREPANCIES BETWEEN THEORETICAL AND EXPERIMENTAL VALUES OF TEMPERATURE BEHIND A SHOCK WAVE
J. Wilson London, HMSO, 1964 34 p refs
(ARC-CP-712; supersedes RAE-TN-AERO-2877, ARC-24772)
HMSO: 6s

In using the sodium-line reversal technique for measuring temperature, a discrepancy between calculated and measured temperatures behind shock waves has been observed. Possible reasons for this discrepancy are discussed. These include boundary-layer effects, reduction of the shock speed caused by dissociation of Na_2, and collision-limiting and nonequilibrium effects on the radiation from the Na. Author

N64-18166* National Bureau of Standards, Washington, D.C.
ABSORPTION SPECTRUM OF THE "PINK" AFTERGLOW OF NITROGEN IN THE VACUUM ULTRAVIOLET
Arnold M. Bass Repr. from J. Chem. Phys., v. 40, no. 3, 1 Feb. 1964 p 695–700 refs
(NASA Order R-64)

The absorption spectrum of the short-lived "pink" afterglow in nitrogen was photographed in the vacuum ultraviolet from 1600 to 1150 A. A large number of relatively intense absorption bands were observed. It is suggested that these may result from transitions between the ground state and several excited electronic states in which ground-state vibrational levels of the ground electronic state are populated to very high levels (up to about $v'' = 20$). It appears that more than 10% of the nitrogen molecules are excited to vibrational levels greater than $v'' = 8$. Author

N64-18182 Birmingham U., (Gt. Brit.)
THE STUDY OF IONIC PROCESSES IN GASEOUS AFTERGLOWS Final Technical Report
D. Smith, M. J. Copsey, and J. Sayers Oct. 1963 85 p refs
(Grant AF EOARDC 61-15)
(AFCRL-64-107; AD-434583)

The report is concerned with measurements of the decay of the densities of ion species in the afterglows following pulsed radiofrequency discharges in atmospheric gases, in order to determine the reaction rates at thermal energies between various ions and neutral species. The observations were made with a mass spectrometer of the linear accelerator type. The following reactions have been investigated: (1) the decay of the He^+ ion density in pure helium afterglows and the subsequent deduction of the ambipolar diffusion coefficient of the He^+ ion in helium. (2) the charge exchange rates of the O^+ ion with oxygen and nitrogen. (3) the charge exchange rates of the He^+ ion with oxygen and nitrogen; and (4) the decay rate of the N^+ ion in pure nitrogen preliminary to charge exchange rate measurements between the N^+ ion and cesium vapor. Author

N64-18313 Massachusetts Inst. of Tech., Cambridge Fluid Mechanics Lab.
COMPRESSIBLE PLASMA FLOW OVER A BIASED BODY
C. H. Su Mar. 1964 39 p refs
(Contract Nonr-1841(93))
(*Its* Publ. 64-3; AD-434731)

The flow field of a compressible plasma over a biased body is discussed, with special emphasis on the electrical characteristics. The governing equations in various asymptotic regions are investigated. A stagnation point probe theory, because of its great practical interest, is given in detail. An analytic current-voltage characteristic is obtained for this case under the assumption of a very thin electrical sheath. Author

N64-18315 Stanford Research Inst., Menlo Park, Calif. Electromagnetic Sciences Lab.
THE MAGNETIC AND IONIC STRUCTURE OF AN ELECTROMAGNETICALLY PRODUCED SHOCK
H. Guthart and T. Morita Jan. 1964 43 p refs
(ARPA Order 281-62; ARPA Order SD-103)
(Tech. Rept. 16; AD-433000)

The structure of the gas behind a strong shock generated by an electromagnetic shock tube has been investigated using magnetic pickup loops, and asymmetrical ion probe, an image-converter camera, and a piezoelectric pressure probe. Four 7.5-μf capacitors were charged to 12 kv and fired into the tube at a pressure of 30 μHg. The azimuthal magnetic field generated by the electrical discharge is "frozen" into the gas behind the shock because of the high magnetic Reynold's number ($R_m \sim 2$). Its transverse distribution is shown to be consistent with a toroidal current hypothesis and a multipole axial distribution corresponding to the damped sinusoidal wave shape of the current in the external circuit. The peak magnetic field strength measured 5,000 gauss at 10 cm from the discharge section and 20 gauss at 40 cm. The peak ion concentration was observed to be 8×10^{14} cm^{-3} at 50 cm and 3×10^{14} cm^{-3} at 190 cm from the discharge section. Author

N64-18336 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
ADMITTANCE OF A WAVEGUIDE RADIATING INTO STRATIFIED PLASMA Scientific Report No. 2
Janis Galejs Aug. 1963 62 p refs
(Contract AF 19(628)-2410)
(AFCRL-63-394; AD-425301)

A slot covered by a stratified plasma is assumed to radiate into a wide waveguide instead of free space. The slot admittance approximates the free-space admittance of the slot for waveguide diameters exceeding 6λ to 10λ. For thick plasma layers, the computed slot admittance checks with earlier admittance calculations for a laterally unbounded plasma. When approximating a plasma profile of a typical hypersonic reentry, a multilayer plasma model in a wide waveguide appears to provide a more accurate slot admittance than a single-layer approximation in a laterally unbounded geometry. Author

N64-18338 Princeton U., N.J. Plasma Physics Lab.
INFLUENCE OF GYRATION RADIUS AND COLLISIONS ON HYDROMAGNETIC STABILITY
Bruno Coppi Oct. 1963 60 p refs
(Contract AT(30-1)-1238; AF AFOSR Grant 62-329; NSF Grant P-579)
(MATT-218)

The stability of three similar low-pressure plasma-equilibrium configurations (sheet pinch, stellarator, and strongly stabilized cylindrical pinch) has been studied by taking into account the effects of collisions and ion gyration radius. Use has been made of a set of macroscopic equations derived from the Fokker-Planck equation. The width of the region where instabilities take place is found to be broadened and, within the limit of the relatively large gyration radius effects, to be essentially controlled by the ion gyration radius, independent of the resistivity and of the magnitude of the wavelength. Within the same limit all the resistivity modes are strongly slowed down, with growth rate independent of the wavelength, and overstable with frequencies of oscillation relatively large compared to the growth rates. Localized and nonlocalized interchange modes with growth rates proportional to $\eta/2^2$ and frequencies proportional to $ka/2$, where η is the resistivity, a the ion gyration radius, and k the wavelength of the perturbation. Author

N64-18340 Princeton U., N.J. Plasma Physics Lab.
ANALOGOUS DIFFUSION OF NEUTRONS AND PHOTONS: A PROPOSED EXPERIMENT
M. D. Kostin and R. C. Axtmann Nov. 1963 15 p refs
(Contract AT(30-1)-1238)
(MATT-231)

An analogy between the diffusion of thermal neutrons in a moderating medium and the diffusion of photons in a light-scattering medium is explored. Theoretical relations are given between the neutron and photon experiments which state that results obtained from one can be used to predict and estimate results to be obtained from the other. Details of a possible experiment are described in which the photon flux in a suspension of polystyrene spheres in water is proportional to the thermal neutron flux in a water assembly of comparable size, except possibly near boundaries, sources, and strong absorbers. The transport theory aspects of the analogy are briefly investigated, and a proportionality between the angular photon and neutron fluxes is suggested. Author

N64-18341 Princeton U., N.J. Plasma Physics Lab.
ANALOGOUS PROPAGATION MODES IN INHOMOGENEOUS PLASMA AND TAPERED WAVEGUIDE
Herbert Lashinsky Dec. 1963 12 p refs
(Contract AT(30-1)-1238)
(MATT-237)

The analogy that exists between the propagation of transverse electromagnetic (TE) waves in a plasma (with no magnetic field) and in conventional waveguide is discussed. This

analogy reflects the similar roles played by the volume conduction current in the plasma and by the wall conduction current in the waveguide. It provides insight into plasma propagation and suggests the possibility of simulating certain microwave properties of inhomogeneous plasma by means of appropriate waveguide configurations. Included are diagrams of: (1) equivalent transmission lines for waveguide and plasma, and (2) tapered waveguide and equivalent plasma density distribution. R.T.K.

N64-18342 Princeton U., N.J. Plasma Physics Lab.
A SOLUTION OF THE KINETIC EQUATIONS FOR A PLASMA INCLUDING RADIATION IN THE PRESENCE OF AN EXTERNAL MAGNETIC FIELD
Ronald Fante Sep. 1963 29 p refs
(Contract AT(30-1)-1238)
(MATT-243)

The solutions of the Simon–Harris hierarchy of equations are obtained and used to derive an equation of radiative transfer for a spatially homogeneous plasma in a constant magnetic field. It is found that, if particle behavior is observed on a time scale of order of the time between collisions, a net radiative transfer is seen to occur. The limiting case of zero magnetic field is also examined. It is then found that the radiative transfer no longer occurs on the collisional time scale, but on some longer scale. Author

N64-18352 Princeton U., N.J. Plasma Physics Lab.
A NEW SOLUTION OF THE KINETIC EQUATIONS FOR A PLASMA INCLUDING RADIATION
Ronald L. Fante Oct. 1963 147 p refs
(Contract AT(30-1)-1238)
(MATT-195)

The Fokker–Planck equation is obtained, along with the rate of energy transfer from the particles to radiation field in an infinite, spatially homogeneous plasma, with and without an external magnetic field applied. For a plasma with no external fields, it is found that there is no transfer of energy from particles to the radiation field for time scales of order of the time between collisions. However, if an external magnetic field is applied, it is found that there is a strong interchange of energy due to cyclotron and synchrotron effects. The emission and absorption coefficients for these processes have been obtained. The behavior of the induction fields in the plasma has been examined, and it has been found that they approach their asymptotic values in times of order of a plasma oscillation (i.e., times of order ωp^{-1}, where ωp is the electron plasma frequency). Author

N64-18354 Ohio State U. Research Foundation, Columbus, Antenna Lab.
PLASMA NOISE MEASUREMENTS Annual Summary Report, 1 Nov. 1962-31 Oct. 1963
30 Nov. 1963 20 p refs
(Contract AF 33(657)-10523)
(Rept. 1573-5; AD-429411)

A program of research is described on the effect of radio noise generated by the hypersonic plasma sheath. It is shown that thermal noise is of major importance under conditions of light plasma formation, such as exists when various methods of plasma control are used. Laboratory measurements of thermal and interference noise in the frequency range 400 to 10,000 mc are described. Author

N64-18436* Polytechnic Inst. Brooklyn, N.Y.
RADIATION FROM A UNIFORMLY ROTATING CHARGE DISTRIBUTION IN A PLASMA IN A MAGNETIC FIELD Final Report, 1 May 1962-30 Apr. 1963
Stanley Gianzero [1963] 14 p
(NASA Grant NsG-165-61, Suppl. 1-63)
(NASA CR-53586; PIBAL-793) OTS: $1.60 ph

The problem of energy radiated in a plasma from a uniformly rotating charge distribution is of importance in connection with the generation of high-power microwave radiation. The dispersion properties of the plasma in a magnetic field may be used to confine the radiation either in the fundamental frequency of rotation of the charge or in a higher harmonic, in which case this radiation mechanism can be used as a frequency multiplier. A simple scheme for the plasma and the charge distribution is used in this analysis to discuss the fundamental properties of the radiated spectrum. Author

N64-18504* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PLASMA DIFFUSION IN THE IONOSPHERE
S. Chandra Repr. from J. Atmospheric and Terrest. Phys., v. 26, 1964 p 113–122 refs
(NASA RP-155)

The equations of motion appropriate to the conditions existing in the ionosphere are evaluated and discussed with a view to examining the condition for ambipolar diffusion ($v_e = v_i$). It is shown that for quasi-equilibrium and isothermal conditions the required condition for ambipolar diffusion is given by curl $v \times B = 0$. It is further shown that the assumption of ambipolar diffusion along the field lines leads to the trivial situation of hydrostatic distributions of electron density independent of latitude. These results are not in agreement with the generally accepted view that diffusion of the plasma along the direction of the magnetic field can account for many geophysical phenomena in the ionosphere. It is pointed out in the paper that the solutions of v_e and v_i in terms of the particle densities and temperatures are not possible without knowledge of the electric field. IAA

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-17866 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
THE EFFECT OF STRESS ON THE LUDERS BAND VELOCITY IN NIOBIUM
H. Conrad and G. A. Stone 12 Nov. 1963 24 p refs
(Contract AF 04(695)-269)
(ATN-64(9236)-5; AD-434098) OTS: $2.60

A study was made of the effect of stress on the Lüders band velocity at room temperature in niobium of two impurity levels. The results indicate that the velocity is uniquely dependent on the effective stress, being independent of specimen length, crosshead velocity, the number of fronts, and the long-range internal stress fields associated with the structure. Author

N64-17870 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
INJECTION LASER STUDY Second Quarterly Progress Report, 1 Sep.-30 Nov. 1963
G. J. Lasher, F. Stern, and K. Weiser [1963] 54 p refs
(Contract DA-36-039-AMC-02349(E))
(AD-430696)

CONTENTS:

1. PROPOSED BISTABLE INJECTION LASER p 6-28 refs (See N64-17871 10-25)
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3. ELECTRICALLY BISTABLE Mn- AND Zn-DIFFUSED GaAs INJECTION LASER p 33-41 refs (See N64-17873 10-25)
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5. ATTEMPTS TO DETECT FLUORESCENCE FROM RARE EARTH DOPE GaAs AND InP p 48 (See N64-17875 10-25)

N64-17871 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
PROPOSED BISTABLE INJECTION LASER
G. J. Lasher, F. Stern, and K. Weiser *In its* Injection Laser Study [1963] p 6-28 refs (See N64-17870 10-25)

The possibility of constructing a bistable injection laser from a single, semiconducting crystal diode is analyzed. A GaAs diode that emits recombination radiation from electrons injected into an active layer on the p-side of the junction is considered. The bistability depends upon nonlinear absorption of light by a portion of the p-side of the junction. Its operation is somewhat analogous to a bistable microwave maser recently constructed by Gerritsen. The analysis is made for the liquid-helium temperatures, assuming the recombining electrons are in the exponential tail of the conduction band. Bistability is predicted, assuming either a constant or a square-root dependence of the density of states in the valence band on energy. For liquid-nitrogen temperature, the numerical results of Lasher and Stern, which refer to parabolic conduction and valence bands, are used. R.T.K.

N64-17873 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
ELECTRICALLY BISTABLE Mn- AND Zn- Diffused GaAs INJECTION LASER
G. J. Lasher, F. Stern, and K. Weiser *In its* Injection Laser [1963] p 33-41 refs (See N64-17870 10-25)

The electrical and optical properties of GaAs diodes prepared by subsequent diffusions of Mn and Zn into n-type GaAs are discussed. Such diodes exhibit a negative resistance over part of their I-V characteristics, and have interesting electroluminescent properties. Laser action was obtained in these structures. The achievement of lasing action is believed to be the result of improved diffusion techniques, which result in very straight diffusion fronts. Lasing thresholds, mode structures, directionality, and near-field patterns of a number of these diodes were examined. At 77° K, the most striking difference between these and ordinary lasing diodes is the fact that lasing action was found to occur some 10 microns away from the p-n junction. There are also indications of a different temperature dependence of the threshold current from that found for ordinary lasers; however, the experiments underlying the observation are preliminary. R.T.K.

N64-17874 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
ELECTROLUMINESCENCE OF Mn DIFFUSED P-N JUNCTIONS
G. J. Lasher, F. Stern, and K. Weiser *In its* Injection Laser Study [1963] p 42-47 refs (See N64-17870 10-25)

The spectral distribution of the light emission from a Zn-diffused diode is shown in graphic form. A comparison of the emissions from a Zn-diffused diode with those from an Mn-diffused diode shows that the high-temperature peak of the Mn-diffused sample is at longer wavelength than that of the Zn sample. It is concluded that the high-temperature emission of the Mn-diffused diode does not proceed via Zn levels. The total light intensity as a function of temperature in Mn- and Zn-diffused diodes was studied; the results are shown in graphic form. A low light intensity, obtained at low temperatures, is considered to be due to the high resistivity near the junction. The light intensity increases with increasing temperature as the resistivity of the diodes decreases. At about 220° K, the light intensity decreased with increasing temperature. The spectral distribution of the emission at liquid-helium temperature was also studied. A tentative value of .88 microns was found for the Mn peak. P.V.E.

N64-17875 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
ATTEMPTS TO DETECT FLUORESCENCE FROM RARE EARTH DOPED GaAs AND InP
G. J. Lasher, F. Stern, and K. Weiser *In its* Injection Laser Study [1963] p 48 (See N64-17870 10-25)

Diodes were made by diffusing zinc into rare-earth-doped GaAs and InP. No fluorescence other than the main band-to-band emissions was observed. Author

N64-17920 Lexington Labs., Inc., Cambridge, Mass.
VAPOR PHASE GROWTH OF SINGLE CRYSTALS Final Report [1 Nov. 1962-31 Dec. 1963]
Philip S. Schaffer Jan. 1964 47 p refs
(Contract AF 19(628)-2383)
(AFCRL-64-57; AD-433232)

A chemical vapor deposition process has been developed for epitaxial growth of sapphire single crystals. Apparatus has been designed and constructed for use in the crystal growth process. Oriented crystals weighing up to five grams have been grown at temperatures considerably below the melting point. The rate of growth for constant gas compositions and flow rates was found to increase with an increase in temperature. Etch pit studies showed an average dislocation density of 10^2 dislocations/cm^2. Spectrochemical analyses indicated total impurity levels below 40 ppm. Author

N64-17961 Wheeler Labs., Inc., Great Neck, N.Y.
STUDY OF LASER OUTPUT PARAMETERS AND MEASUREMENT TECHNIQUES Final Report, 20 May-20 Nov. 1963
E. R. Schineller, H. M. Heinemann, H. W. Redlien, and R. A. Kaplan Griffiss AFB, N.Y., RADC, Feb. 1964 163 p refs
(Contract AF 30(602)-3132)
(Rept. 1182; RADC-TDR-63-564; AD-433174)

A detailed study has been made of the laser parameters associated with system applications involving both energy and information transfer. The approach to the study has included a discussion of the fundamental properties of

EM radiation, independent of specific laser types, the determination of system parameters, and their relation to these fundamental properties. The specific output parameters of the solid state, gaseous, and diode lasers were computed theoretically, and measurement principles were reviewed. The study has resulted in definitions of a wide variety of parameters needed to describe the many different properties of laser radiation in space and time. The results are presented in a set of tables of indicated system parameters, system relations, and the applicable laser parameters. Theoretical considerations based on the concept of the laser as a multimode oscillator have led to the adoption of conceptual models for each of the three laser types. Author

N64-17968 Louvain U. (Belgium) Lab. of Physical Chemistry
HIGH FREQUENCY "FORMING" OF CADMIUM SULPHIDE SINGLE CRYSTALS
Jacques Stoquart and André Luyckx *In its* Photovoltages and Adsorbed Gases in CdS. Interpretation of High Freq. "Forming" of CdS Single Crystals. Thermoele. Power of Annealed and Cold-Worked Bismuth Dec. 1963 p 15–19 refs (See N64-17966 10-23)

A conventional type of leak detector was used to produce a spark of approximately 1 centimeter in length, which was directed into a wire in contact with the CdS crystals. The spark was maintained from one to several seconds. Generally, the conductivity of the crystal was found to be notably higher after high-frequency excitation. R.T.K.

N64-17983 Bureau of Mines, Salt Lake City, Utah
INFRARED STUDY OF THE EFFECT OF FLUORIDE, SULFATE, AND CHLORIDE IONS ON ADSORPTION OF OLEATE ON FLUORITE AND BARITE
Alan S. Peck and Milton E. Wadsworth 1964 19 p refs
(BM-RI-6412)

An investigation was made of the effects of fluoride, sulfate, and chloride ions on the adsorption reaction between sodium oleate and water suspensions of synthetic fluorite and barite. Infrared analytical methods permitted identification of chemisorbed oleate and physically adsorbed sodium oleate species on each mineral, and quantification of the changes induced by different concentrations of the sodium salts. Sodium fluoride had a marked effect on the formation of absorbed films on fluorite. Sodium sulfate had a similar effect on the formation of films on barite. In each instance the sodium salt sharply inhibited the formation of the chemisorbed oleate specie and permitted the formation of physically absorbed sodium oleate. Sodium salts containing anions different from that of the mineral and measurable but relatively little effect on the reaction between sodium oleate and the minerals. Author

N64-17987* Stanford Research Inst., Menlo Park, Calif.
ATOM DENSITY MEASUREMENTS BY LUMINESCENCE OF SOLIDS
K. M. Sancier, D. J. Schott, and H. Wise Washington, NASA, Apr. 1964 82 p refs
(NASA Contract NASr-49(09))
(NASA CR-20) OTS: $2.00

The lumophor CaO:Sb:Cl was selected for a detailed study of oxygen and nitrogen atom densities. The study included an evaluation of (1) the quantitative relationship between luminescence intensity and the atom density measured by electron spin resonance (ESR), (2) the effect of extended exposure to atoms, and (3) the mechanisms of energy transfer leading to luminescence. Author

N64-18023 Raytheon Co., Waltham, Mass. Research Div.
MULTIMODE OSCILLATIONS IN SOLID STATE MASERS Interim Scientific Report
H. Statz and C. Tang Oct. 1963 29 p refs
(Contract AF 19(628)-3226)
(AFCRL-63-917; AD-433282)

Previous work on the effects of slow spatial cross relaxation is extended. Off-axis modes are included in the calculations, and thus it becomes possible to calculate the number of oscillating off-axis modes as a function of the various laser parameters. In this way the expected beam angle of a laser can be predicted. A more detailed analysis of the spiking behavior is given. It is shown that both regular and irregular spiking trains may be obtained depending upon the laser parameters and the pump power. Author

N64-18031 IIT Research Inst., Chicago, Ill.
INVESTIGATION OF NARROW LINE PARAMAGNETIC RESONANCE ABSORPTION SPECTRUM IN SINGLE CRYSTAL CALCITE Report No. 13 (Final), Dec. 27, 1962–Dec. 27, 1963
S. A. Marshall Griffiss AFB, N.Y., Commun. Res. Branch, Mar. 1964 55 p refs
(Contract AF 30(602)-2912)
(RADC-TDR-64-34; AD-433680)

Results of a program of study on the narrow-line paramagnetic resonance absorptions in single crystals of calcite are presented. These include an analysis carried out on the spectrum of the trivalent iron isotopes, Fe^{54}, Fe^{56}, and Fe^{57}, in calcite and the spectral shifts associated with these isotopes, and analysis of the spectrum of the molecular ion CO_2^-, and the superhyperfine structure in the divalent manganese ion spectrum due to the magnetic interaction of the C^{13} isotope with the manganese ion. Author

N64-18038 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
LOW TEMPERATURE VAPOR GROWTH STUDIES Scientific Report No. 2
M. Berkenblit et al 31 Dec. 1963 83 p refs
(Contract AF 19(628)-2468)
(AFCRL-64-63; AD-433640)

An investigation of disproportionation growth of epitaxial germanium included studies of the HI transport system—experimental conditions and substrate preparation, effects of substrate orientation, and characteristics of the grown deposits. Reduction growth of single crystals was investigated as follows: (1) germanium vapor growth in the system: $GeCl_4$–H_2–Ge; (2) the Ge–Cl system—Bourdon gage studies and light-stimulated etching of Ge by $GeCl_4$; and (3) optical studies of the $GeCl_4$–Ge system. R.T.K.

N64-18059 Franklin Inst., Philadelphia, Pa.
TORQUE AND ROTATIONAL HYSTERESIS IN FCC SINGLE CRYSTAL COBALT FILMS Scientific Report No. 1
William D. Doyle Bedford, Mass., AFCRL, Dec. 1963 10 p refs Presented at 9th Magnetics Conf., Atlantic City, N.J., Nov. 1963 Submitted for Publication
(Contract AF 19(628)-2415)
(AFCRL-64-41; AD-432825)

The Stoner–Wohlfarth coherent rotation model is extended to the case of biaxial anisotropy. The rotational hysteresis W_r as a function of reduced field h is found to be zero for all values of h except $0.25 \leq h \leq 1$ with the maximum value of $W_r/K = 2.38$ at $h = 0.25$. The rotational hysteresis integral W equals

1.54. Measurements on fcc single crystal Co films ($-k = 4$ to 6×10^5 ergs/cc) prepared by epitaxial evaporation onto the (100) face of single crystal MgO slabs held at 400° C yield results in wide disagreement with the theory. Whereas the expected angular symmetry of the torque is observed, the model does not correctly predict the magnitude of the torque nor the fields at which specific types of angular dependence will be observed. Author

N64-18060 Franklin Inst., Philadelphia, Pa.
VOIDS IN AGED SINGLE CRYSTAL PERMALLOY FILMS Scientific Report No. 2
Alfred Baltz Bedford, Mass., AFCRL, Dec. 1963 14 p refs Presented at Philco Corp. Single Crystal Film Conf., Apr. 1963
(Contract AF 19(628)-2415)
(AFCRL-64-42; AD-432857)

Permalloy films epitaxially grown on NaCl in a vacuum of 10^{-9} torr were examined before and after aging at room temperature. The original films were near perfect single crystals exhibiting rather sharp Kikuchi lines. After aging the films for two months, regions were observed that were considerably thinner than the rest of the film. Diffraction patterns of these thin regions showed that they were polycrystalline and could be identified as nickel oxide. The remainder of the film was still single crystalline. After aging for 3 months, the thin regions had deteriorated into voids whose sides were oriented along crystallographic directions. Square, rectangular, and octagonal voids were observed, depending upon whether the voids lay in (100), (110), or (111) planes. Author

N64-18117 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
MECHANISM OF CONDUCTION IN LI-SUBSTITUTED TRANSITION METAL OXIDES
R. R. Heikes and W. D. Johnston 23 Mar. 1956 26 p refs
(Sci. Paper 60-8-0628-P5)

A study of the effect of Li substitution on the electrical properties of the oxides MnO, CoO, NiO, and CuO has been made. It has been found that: (1) The activation energy for conduction increases abruptly near the antiferromagnetic Curie points. (2) As Li is added the activation energy and resistivity initially decrease rapidly and then level off in the neighborhood of 2% substituted Li. (3) This initial decrease becomes progressively greater in going from MnO to CuO in the sequence of the periodic table. A rather complete understanding of these materials can be had by treating the conduction process as a thermally activated diffusion of positive holes that are trapped by the local strain induced by their own polarization field. The magnitude of the activation energy will be related to the work done against elastic forces necessary to reduce the local strain at a positive hole to zero. Author

N64-18126 Ecole Normale Superieure, Paris (France) Lab. de Physique
RADIATION DAMAGE IN SEMICONDUCTORS Annual Summary Report, No. 2
P. Baruch et al 23 Jul. 1963 13 p refs
(Contract AF 61(052)-543)
(AFCRL-63-578; AD-433042)

CONTENTS:

1. RADIATION ENHANCED DIFFUSION IN SILICON p 3-6 refs (See N64-18127 10-25)
2. STORED ENERGY IN IRRADIATED SEMICONDUCTORS p 7-10 (See N64-18128 10-25)
3. DEFECT MOBILITY IN IRRADIATED SEMICONDUCTORS p 11-13 ref (See N64-18129 10-25)

N64-18127 Ecole Normale Superieure, Paris (France) Lab. de Physique
RADIATION-ENHANCED DIFFUSION
P. Baruch et al *In its* Radiation Damage in Semiconductors 23 Jul. 1963 p 3-6 ref (See N64-18126 10-25)

The same enhancement of diffusion as with protons is observed in electron-irradiated silicon. This confirms the point-defect mechanism proposed earlier. The proton-irradiated samples have been observed by X-ray microtopography and show a pattern of strains due to small-scale defects, but no new extended dislocations. Author

N64-18128 Ecole Normale Superieure, Paris (France) Lab. de Physique
LOW TEMPERATURE IRRADIATION OF GERMANIUM STORED ENERGY MEASUREMENT
P. Baruch et al *In its* Radiation Damage in Semiconductors 23 Jul. 1963 p 7-10 (See N64-18126 10-25)

Stored energy measurements after a 14° K electron irradiation have been attempted, but the effect is masked by thermal phenomena accompanying the adsorption of residual gases in the calorimeter chamber. Author

N64-18129 Ecole Normale Superieure, Paris (France) Lab. de Physique
STUDY OF DEFECT MOBILITY IN IRRADIATED SEMICONDUCTORS
P. Baruch et al *In its* Radiation Damage in Semiconductors 23 Jul. 1963 p 11-13 (See N64-18126 10-25)

Radiation-induced defects in silicon can drift in the electric field of a p-n junction, as in germanium. At 288° K, there is drifting of defects with different charges, the acceptor type (negatively charged) being the slower. At 350° K, only acceptor type defects are seen to move, with a mobility of 2×10^{-14} cm^2/v-sec. Author

N64-18167* Rice U., Houston, Tex.
SPIN-LATTICE INTERACTION IN RUBY
P. L. Donoho and R. B. Hemphill Repr. from Proc. Intern. Conf. on Low Temp. Phys., 8th p 294-295 refs
(NASA Grant NsG-6-59)

The spin-lattice interaction in ruby containing 0.05% Cr^{+++} was investigated by measuring the effect of uniaxial stress on the electron-spin-resonance spectrum. Line shifts proportional to the applied stress have been observed at a frequency of 10.1 Gc for all observable transitions and for various directions of the stress. The observed shifts and the components of the magnetoelastic tensor computed from the observed line shifts agree quite well with the work of others. The spin-lattice relaxation time for direct one-phonon transitions can be computed from knowledge of the magnetoelastic tensor G. Crude computation of the relaxation time indicates that exchange interactions should be negligible for extremely small chromium concentrations, and that the direct one-phonon process should dominate, although cross relaxation is still important. Exact computation of one-phonon relaxation times at 10 Gc using the values for the G tensor obtained in this experiment is in progress. M.P.G.

N64-18202 General Electric Co., Schenectady, N.Y. Research Lab.
RESEARCH ON CdTe Eighth Quarterly Progress Report, 1 Feb.-30 Apr. 1963
M. R. Lorenz, R. E. Halsted, and B. Segall Wright-Patterson AFB, Ohio, Aeron. Res. Lab., [1963] 26 p refs
(Contract AF 33(616)-8264)
(AD-404859)

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1. DOUBLE ACCEPTOR FLUORESCENCE IN II-VI COMPOUNDS R. E. Halsted and B. Segall 6 p refs (See N64-18203 10-25)

2. PARAMAGNETIC RESONANCE OF CHROMIUM IN CdTe G. W. Ludwig and M. R. Lorenz 15 p refs (See N64-18204 10-25)

N64-18203 General Electric Co., Schenectady, N.Y. Research Lab.

DOUBLE ACCEPTOR FLUORESCENCE IN II-VI COMPOUNDS

R. E. Halsted and B. Segall *In its* Res. on CdTe [1963] 6 p refs (See N64-18202 10-25)

An attempt is made to show that the unique characteristics of a radiative recombination process can be examined in terms of the properties of a native double-acceptor defect, recently identified in electrical transport measurements. The fluorescent emission characteristic of this defect is studied in terms of the native double acceptor, which has a doubly ionized level close to the conduction band. From the study, it is seen that the specific concept of a doubly ionized native-acceptor level near the conduction band, coordinating transport and fluorescence measurements, provides a basis for a detailed understanding of the characteristics of emission in group II-VI compounds. C.L.W.

N64-18204 General Electric Co., Schenectady, N.Y. Research Lab.

PARAMAGNETIC RESONANCE OF CHROMIUM IN CdTe

G. W. Ludwig and M. R. Lorenz *In its* Res. on CdTe [1963] 15 p refs (See N64-18202 10-25)

A report is given on the paramagnetic properties of chromium in the $3d^5$ configuration in cadmium telluride, a cubic crystal having the zincblende structure. Sample preparation, properties, and the resonance spectrum are described. A description is presented of an electron-nuclear double-resonance technique used to examine samples in order to gain information on the hyperfine interactions with Cr^{53} and with the magnetic Cd isotope. Results of the study are discussed. C.L.W.

N64-18214* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

EFFECT OF ELECTRON SPIN PARAMAGNETISM ON THE VELOCITY OF SOUND IN METALS

Oldwig von Roos Repr. from Phys. Rev., v. 133, no. 1A, 6 Jan. 1964 p A182-A183 refs

(NASA Contract NAS7-100)

(NASA CR-53533; JPL-TR-32-507)

By means of a simple calculation, it is shown that the interaction of an external magnetic field with the magnetic moment of the conduction electrons in a metal gives rise to an increase in the velocity of sound that is independent of the angle between the direction of the magnetic field and the direction of propagation of the sound wave. Author

N64-18225 Rensselaer Polytechnic Inst., Troy, N.Y.

INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIALS Third Quarterly Progress Report, 1 Aug.-31 Oct. 1963

Roland M. Lichtenstein [17 Feb. 1964] 20 p refs

(Contract DA-36-039-AMC-02165(E))

(AD-433623)

A high-frequency technique has been developed for the measurement of bulk carrier lifetime in silicon samples. The use of contacts has been eliminated. The technique is based on the measurement of the Q-value of a tank circuit that contains the sample. A single tube (6J6) is used to generate the oscillations and to measure transient changes of the Q-value. Author

N64-18255 Clevite Corp., Palo Alto, Calif. Shockley Lab.

FAILURE MECHANISMS IN SILICON SEMICONDUCTORS Quarterly Report No. 3, [1 Sep.-30 Nov. 1963]

H. Queisser, W. Schroen, and W. Hooper Griffiss AFB, N.Y., RADC, Mar. 1964 55 p refs

(Contract AF 30(602)-3016)

(RADC-TDR-64-6; AD-434762)

Surface studies show that there is motion of charge horizontally on the oxide covering planar silicon junctions. There is insignificant dipole action and diffusion through the oxide under normal operating conditions of such devices. The high field of the junction space charge layer is not necessary for the observed effects. Relations of oxide contact potential and device parameter changes are described. Reverse V-I characteristics are changed strongly by surface charge, which is measured by the Kelvin vibrating-condenser method. The problem of lateral thermal instability in silicon power transistors and its relationship to the "second breakdown" phenomenon was investigated further. Emphasis was put on those transistors that exhibited second breakdown at spots initially showing no elevated temperatures. The pathology of the damage produced by current concentrations was studied in more detail. Author

N64-18301* Chicago U., Ill.

QUANTUM EFFICIENCY OF SILICON IN THE VACUUM ULTRAVIOLET

A. J. Tuzzolino [1962] 8 p refs

(NASA Grant NsG-179-61)

(NASA CR-53104) OTS: $1.10 ph

A measurement of the quantum efficiency of silicon has been carried out over the photon energy range from 4.9 to 21.2 ev by measuring the photoresponse of silicon surface-barrier photodiodes. The quantum efficiency increases from 2.0 at $h\nu$ = 4.9 ev to approximately 3 at $h\nu$ = 6 ev; between $h\nu$ = 6 ev and $h\nu \approx$ 10 ev, the quantum efficiency is approximately constant and beginning at $h\nu \approx$ 10 ev, increases strongly with increasing photon energy, attaining a value of 15 at 21.2 ev. This observed behavior is consistent with qualitative predictions based upon a model for secondary ionization effects in silicon proposed by Shockley and a simplifying assumption as to how the excess energy available following an ionization event is distributed between the original carrier and generated electron-hole pair. Author

N64-18463 Princeton U., N.J. Frick Chemical Lab.

CELL MODEL FOR DIFFUSE PHASE TRANSITION

Arthur V. Tobolsky Mar. 1964 6 p refs

(Contract Nonr-1858(07))

(ONR-TR-RLT-73; AD-432240)

A lattice is considered on which two different phases of the same molecule coexist. Phase B is dispersed in phase A, and phase A is dispersed in phase B. However, each region of phase A or of phase B is assumed to be wholly enclosed by a boundary. The assumption is made that the same coordination number z is valid for the lattice of phase A and of phase B. It is also assumed that the pair partition function for an aa pair is f_{aa}, for an ab pair is f_{ab}, and for a bb pair is f_{bb}. A cell model for the total lattice of n molecules is considered. A comparison is made between the treatment presented and the Zimm-Bragg theory. Both theories are in the form of cell models for describing a diffuse phase transition. R.T.K.

N64-18484 Midwest Research Inst., Kansas City, Mo.
THE STRUCTURE AND STRENGTH OF EPITAXIAL FILMS Bimonthly Progress Report No. 2 17 Dec. 1963-17 Feb. 1964
M. Lavik, A. Cunningham, and P. Bryant 16 Mar. 1964 33 p refs
(Contract NOw-64-0061-d)
(AD-434805)

The literature review initiated in the previous report has been extended and categorized with a coding system. The coded bibliography containing 200 references is included in this report. A vacuum system, evaporation chamber, substrate holder, and straining device have been designed. A brief discussion of these units, with drawings, is included. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-17869 Maremont Corp., Pasadena, Calif. Research and Development Labs.
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Quarterly Report No. 10, 1 Sep. 1963-30 Nov. 1963
M. A. Greenbaum, R. E. Yates, J. A. Blauer, M. Arshadi, H. C. Ko et al [1963] 14 p refs
(Contract AF 04(611)-7414)
(QR-7414-10; AD-433853) OTS: $1.60

The reaction of BeO(s) with H_2O(g) between 1,500° to 1,700° K is still under investigation. Preliminary results from a study of the AlF_3(g)-Al(l) reaction indicate that the heat of formation of AlF(g) is near the value reported in the JANAF Tables. Initial results obtained from a study of the BF_3(g)-B(s) reaction indicate that BF(g) requires a temperature at least 300° K higher than predicted from the JANAF Tables to be formed from the indicated reaction. Author

N64-18009 General Dynamics/Astronautics, San Diego, Calif.
GASDYNAMICS OF ROCKET EXHAUST PLUMES
H. Yoshihara 31 Dec. 1963 33 p refs
(GD/A-63-1381; ERR-AN-440)

A reexamination of existing methods to compute rocket exhaust plumes with laminar or turbulent mixing is made. Two limiting cases, the low-altitude case and the high-altitude case, are discussed. The problem of scaling is briefly reviewed. Author

N64-18029 Monsanto Research Corp., Everett, Mass. Boston Lab.
EFFECTS OF SELECTED STRAINS OF MICROORGANISMS ON THE COMPOSITION OF FUELS AND LUBRICANTS Technical Documentary Report, 1 Sep. 1962-31 Aug. 1963
John O. Smith, Glenn R. Wilson, Dolph Klein, and E. C. Harrington Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 76 p refs
(Contract AF 33(657)-9814)
(RTD-TDR-63-4117, Pt. 1; AD-433250)

A total of 35 jet fuel samples, 1 lubricant, and 44 pure hydrocarbons have been screened for growth and nongrowth support for 16 aerobic bacterial cultures. Thirty of these jet fuels, the 1 lubricant, and 11 of the pure hydrocarbons were also screened against 5 fungal cultures for growth- and nongrowth-supporting properties. Only 1 of the 35 jet fuel samples completely resisted bacterial attack. The remainder varied in their growth support of the bacterial cultures. All 30 jet fuel samples, except a contaminated JP-4 sample, showed varied growth support for the 5 fungal cultures. The 1 lubricant sample completely resisted attack by 4 of the 5 fungal cultures. Only n-cetane, from among the 11 pure hydrocarbons screened (napthenes and n-cetane) supported fungal growth. Preliminary analysis of the completely bacteria-resistant jet fuel samples showed that it contained no n-alkanes. Author

N64-18137 Northern Research and Engineering Corp., London (Gt. Brit.)
AN ANALYTICAL METHOD OF COMPUTING REACTION RATES FOR HYDROGEN-AIR MIXTURES
I. N. Momtchiloff and E. D. Taback (Pratt and Whitney Aircraft, East Hartford, Conn.) [1961] 22 p refs

An analytical method of estimating autoignition delay time, based on the dissociation and recombination rates of the various reactions, has been developed for hydrogen–air mixtures. The one-dimensional gas dynamics equations are combined with reaction kinetics equations to formulate a set of (n + 5) simultaneous nonlinear first-order differential equations (where n is the number of reactions considered) that describe the behavior of a mixture of reacting gases flowing supersonically down a duct. A computer program is evolved and is used to solve these equations for the particular case of air–hydrogen mixtures. The delay periods obtained are in good agreement with the limited amount of experimental data available for hydrogen and air. Since the autoignition delay time is of considerable interest for hypersonic ramjets, the ignition delay lengths for typical supersonic combustion inlet conditions have been estimated. Author

N64-18141 Ministry of Aviation, Mottingham (Gt. Brit.) Technical Information and Library Services
TEMPERATURE DISTRIBUTION IN AMMONIUM PERCHLORATE WHEN BURNING [O PROFILYAKH TEMPERATUR PRI GORENII PERKHLORATA AMMONIYA]
V. K. Bobolev, A. P. Glazkova, A. A. Zenin, and O. I. Leipunskii Jan. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 151, no. 3, 1963 p 604–607
(TIL/T.5475)

Results of measurements of temperature distribution in ammonium perchlorate during combustion by the use of thin thermocouples are reported and discussed. Curves are obtained for the pressure range 40 to 350 atm. Both a stable and an unstable regime were detected. Anomalies have been found in the relation between surface temperature and pressure, and between the heat released in the condensed phase and the pressure. Author

N64-18150 Bureau of Mines, Bartlesville, Okla.
AVIATION FUELS, 1963
O. C. Blade Apr. 1964 23 p refs
(*Its* Petrol. Prod. Surv. 34)

Summarized data of the average values of the tests of commercial aviation gasolines in the present survey are compared with survey data of previous years from 1953. Trends in certain characteristics of four of these fuels from 1953 may be seen in graphs that also indicate the minimum and maximum values. Properties of two types of aviation turbine fuels of 1963 are compared with summarized data on similar fuels for preceding years. Author

N64-18177 Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Final Technical Report
D. L. Hildenbrand, L. P. Theard, and F. Ju 30 Jan. 1964 20 p refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(Publ. U-2485; RPL-TDR-64-36)

A summary of results obtained in a program to provide thermodynamic data for beryllium species, in cases where critical uncertainties exist, are presented. Work to determine the heats of formation of gaseous species in the Be-O, Be-O-H, Be-F, and Be-Cl systems is discussed in particular. P.V.E.

N64-18179 Hayes International Corp., Birmingham, Ala.
DESIGN STUDY FOR INFRARED MEASUREMENT OF PYROTECHNIC FLARES
W. S. Cronk Eglin AFB, Fla., Directorate of Armament Develop. Mar. 1964 44 p
(Contract AF 08(635)-3789)
(ATL-TDR-64-10; AD-433964)

The results of this contract provide design criteria for radiometric equipment and establish a standard technique to obtain reproducible infrared measurements of pyrotechnic flares when performed by untrained personnel in a wide variety of ambient conditions. The method used to specify the design criteria has been to complete the actual design of an infrared measurement system whose characteristics have been selected as being optimum for flare measurements. Author

N64-18257 Naval Ordnance Lab., White Oak, Md.
INITIATION OF EXPLOSIVES BY EXPLODING WIRES
Howard S. Leopold 15 May 1963 44 p refs
(NOLTR-63-159; AD-424518)

The effects of circuit inductance and bridgewire length on the initiation of PETN by exploding platinum wires were investigated. A capacitor discharge was used as the energy source. Oscillograms of current and voltage coincident with smear camera records were used to interpret the wire explosion and initiation processes. Increasing circuit inductance lowers the probability of producing detonation in PETN by an exploding wire. Secondary current pulses have little effect on whether or not detonation results. For effective initiation the bridgewire length should be chosen to eliminate current dwell. Author

N64-18312 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FACTORS INFLUENCING THE THERMOSTABILITY OF JET ENGINE FUELS
I. N. Danilov and Kh. A. Murzabulatov 14 May 1963 20 p refs Transl. into ENGLISH from the book, "Sernistyye Nefti i Produkty Ikh Pererabotki", Moscow, Gostoptekhizdat., 1962 p 238-250
(FTD-TT-63-343/1+2+4; AD-407364)

The effects of various factors on the thermostability of TS-1 jet-engine fuel were investigated under fuel-injection conditions. Results are: (1) A nitrogen blanket or a blanket of fuel vapors over the fuel significantly increases the thermostability. (2) A change of the heating rate, an increase of the heating length, cooling the fuel, and its repeated heating up to the same temperature have little effect on the thermostability index of the fuel. (3) Thermostability, when the fuel contacts air, does not depend on the preheating temperature if this temperature does not exceed the maximum heating temperature of the fuel. (4) Thermostability, when the fuel contacts nitrogen, is determined not only by the maximum heating temperature but also by its preheating temperature. When this preheating temperature approaches the maximum heating temperature, the thermostability of the fuel is increased. It is indicated that the thermostability of fuel TS-1, on contact with air, satisfies the demands for thermostability at temperatures up to 100° to 110° C. I.v.L.

N64-18470 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RIFT RADIATION EFFECTS PROGRAM, IRRADIATION NO. 9: MONOMETHYL HYDRAZINE
A. J. Steele 15 Feb. 1964 37 p refs
(NSP-64-10)

A radiation test was conducted on monomethyl hydrazine to evaluate the effects of reactor radiation on (1) the hypergolicity of this material with nitrogen tetroxide as the oxidizer, and (2) the production of off-gas. In addition, the effects of radiation on viscosity, density, melting point, and the monomethyl hydrazine assay were also measured. Samples of monomethyl hydrazine were exposed to an integrated flux of approximately 5×10^{15}nvt (E > 0.5 Mev) and 1×10^{8}r. Based on measurements of ignition time delay, this exposure produced no significant effect on the hypergolicity of monomethyl hydrazine when oxidized with nitrogen tetroxide. After exposure to 1×10^{8}r, the off-gas volume (at 1 atmosphere pressure and 77° F) was 21 ml per ml of liquid. The chromatographic analysis of the off-gas showed it to be a mixture of approximately 28-mole-percent hydrogen, 41-mole-percent nitrogen, and 31-mole-percent methane with minor amounts of oxygen, ammonia, and monomethyl hydrazine vapor. The irradiated liquid material exhibited a 4.5-percent decrease in monomethyl hydrazine assay, a 5.5-percent increase in viscosity, and a 0.9-percent increase in density. The melting point was unaffected by radiation. Author

N64-18495 Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
INITIATION OF DETONATION BY LOW AMPLITUDE SHOCKS Semi-Annual Report, 1 Aug. 1963-31 Jan. 1964
F. C. Gibson, R. W. Watson, J. E. Hay, C. R. Summers, and F. H. Scott 10 Apr. 1964 39 p refs
(ARPA Order 44-63, Amend. 6)
(Rept. 3916)

Mechanisms leading to the initiation of detonation in explosives and propellants are discussed. Emphasis was placed on reactions that occur in liquid explosives and sensitive liquid systems as a result of relatively mild shock stimuli. Ensuing reactions take the form of low-velocity detonations wherein the velocity of the reaction is only slightly higher than the sonic velocity in the liquid and less than the sonic velocity in the wall of the liquid's container. If both the liquid and the container are subjected to the same stimulus, e.g., an attenuated shock wave from a solid explosive donor that is less than that required to instantaneously initiate the material to a high-velocity detonation, then the waves in the container wall as well as the waves in the liquid have adequate time to disrupt the homogeneity of the system. As a result of the liquid breakup and subsequent decomposition, a reaction wave is generated that is unstable when the container has a sonic velocity less than that of the liquid but is steady when the cavitational process is continuously induced by the wall waves. I.v.L.

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-18047 Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero-Propulsion Lab.
AN ANALYSIS OF RADIOISOTOPE POWERED THRUSTORS FOR SPACE PROPULSION Technical Documentary Report, Jun. 1962- Apr. 1963
Robert F. Cooper and Richard L. Verga Oct. 1963 17 p refs
(ASD-TDR-63-787; AD-425715)

Radioisotopes provide long-lived, highly concentrated energy sources. The utilization of radioactive isotopes in a hydrogen heat-transfer rocket for space propulsion appears extremely attractive. The decay radiation from a radioisotope source would be used to heat an absorber. A propulsive fluid, or expellant, would in turn be heated by passing it over the hot absorber; the fluid would then be expelled through a nozzle to produce thrust. If the heating elements were maintained at temperatures of about 5,000° F, a device of this type could produce specific impulses up to 1,000 sec. Such a thrustor possesses inherent advantages over electrothermal propulsion devices of comparable thrust and specific impulse capabilities. Isotope-powered thrustors are conceptually simple, reliable, capable of long-operating lifetimes, and require no auxiliary source of electrical power. Author

N64-18100* General Motors Corp., Indianapolis, Ind. Allison Div.
DESCRIPTION AND INSTALLATION OF ALL/TROL CONTROL SYSTEM, ALLISON MODEL PD-48-A2
R. C. Fall 8 Jan. 1964 27 p
(NASA Contract NAS8-5045)
(NASA CR-53368; EDR-3224) OTS: $2.60 ph

The PD-48-A2 attitude and velocity control system (designated ALL/TROL) contains all the components and wiring necessary to receive guidance signals from an external source, and to convert these electrical signals into a corrective force by rotation of the control rockets. The system consists of four solid-propellant rocket motors, an actuation motor and position feedback potentiometer for each control rocket, support structure, electrical harness, and a mounting flange for installation on the Vector Research Vehicle. The control rockets, which are solid-propellant end-burning motors with the nozzles located at 80° to the propellant grain center line, are so located that one pair of parallel rockets, rotated in the same direction, will provide control in the yaw plane, and the other pair of rockets will provide control in the pitch plane. Differential rotation of the rockets for either one pair or both pairs will provide roll control. The procedures to be followed for the assembly and installation of the control rockets are discussed. I.v.L.

N64-18120* Minneapolis-Honeywell Regulator Co., Minn.
ROCKET BOOSTER CONTROL, SECTION I – SUMMARY
E. E. Fisher, M. E. Gollwitzer, C. A. Harvey, E. B. Lee, and E. R. Rang 6 Feb. 1964 35 p
(NASA Contract NASw-563)
(NASA CR-53360; MH MPG-1541-TR 1) OTS: $3.60 ph

This discussion separates the efforts into three categories: initial condition control, measurement (of the state vector), and load disturbance control. The efforts in each of the categories are related, and a summary of each effort is provided. A review of linear programing is provided. Initial considerations leading toward solutions of the load disturbance control problem are presented. Author

N64-18173* United Aircraft Corp., East Hartford, Conn. Research Labs.
STUDY OF THE APPLICATION OF ELECTRIC PROPULSION TO SPACE MISSIONS Quarterly Progress Report No. 3
W. R. Fimple Mar. 1964 38 p refs
(NASA Contract NASw-737)
(NASA CR-53472; C-910076-3) OTS: $3.60 ph

The application of SNAP-50 to the Jupiter probe mission was considered, assuming the use of the Saturn IB launcher. The study of the lunar logistic supply operation was extended to include the use of the Saturn V as the launcher. For this mission, a performance comparison of electric propulsion with the solid-core nuclear rocket was made, and the results are presented in terms of launch rate and weight launched into earth orbit per unit weight delivered to the lunar surface as functions of the lunar supply rate. Author

N64-18198 Calorobic Materials, Inc., Pearl River, N.Y.
DEVELOPMENT AND UTILIZATION OF OPTIMUM TECHNIQUES FOR THE FABRICATION OF TITANIUM BORONITRIDE ROCKET NOZZLES Final Report, 1 Jul. 1962-28 Feb. 1964
R. Strickman Watertown, Mass., Army Mater. Res. Agency, Feb. 1964 30 p
(Contract DA-30-069-ORD-3747)
(TR-371.9/7; AD-433662)

Two techniques described in this report were used to produce all of the test specimens and rocket nozzle inserts. All the test specimens, the HTB-2, and three of the HTB-3 rocket nozzle inserts were made by the conventional method in accordance with specifications. A proprietary method involving core heating was used to produce 9 of the 1-in. throat diameter HTB-3 rocket nozzle inserts and 10 of the 2-in. throat diameter HTB-4 nozzles in accordance with specifications. With the latter method, which initially demonstrated the feasibility of the concept and subsequently involved a scale-up of the operation, the appropriate apparatus was designed, constructed, and placed into operation. Author

N64-18218* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
AN EXPERIMENTAL INVESTIGATION OF UNCOOLED THRUST CHAMBER MATERIALS FOR USE IN STORABLE LIQUID PROPELLANT ROCKET ENGINES
R. W. Rowley 15 Feb. 1964 30 p refs
(NASA Contract NAS7-100)
(NASA CR-53529; JPL-TR-32-561) OTS: $2.60 ph

An experimental investigation of the comparative merits of various uncooled thrust chamber materials was conducted by performing engine tests in which N_2O_4/N_2H_4 propellants were used at a nominal mixture ratio of 1.0. The chamber pressure was 150 psia and the nominal sea-level thrust was 85 lb. Erosion of graphites, ablative plastics, and refractory metals was found to be a function of the local thermal and chemical environments existing at the thrust chamber wall. The role of a particular impinging-stream injector in influencing local conditions at the wall was determined by (1) evaluating the properties of the spray produced by nonreacting liquids, and (2) measuring local heat-transfer rates to the chamber wall in the operating rocket engine by means of embedded thermocouples and a transient conduction analysis. Local erosion of Refrasil-phenolic, pyrolytic graphite, and ZT graphite nozzle throats tested with this injector was found to be qualitatively related to these local gas-side boundary conditions. Author

N64-18256 Aeronutronic, Newport Beach, Calif.
INTERNAL ENVIRONMENT OF SOLID ROCKET NOZZLES Third Quarterly Technical Report, 1 Dec. 1963-29 Feb. 1964
F. C. Price, V. A. Marple, and R. A. Dupuis 30 Mar. 1964 75 p refs
(Contract AF 04(611)-9072)
(Publ. U-2543; RPL-TDR-64-45; AD-434129)

The Philco Research Laboratories are conducting a study of solid-propellant nozzle environment to implement nozzle design methods; study of the condensed phase effects is emphasized. Cold-flow modeling technique has been developed to the point of showing quantitative particle impingement rates for the 60-in.-diam engine modeled. Engine firing tests have provided the first data on heat fluxes to a molybdenum nozzle wall showing the effects of impinging alumina. A scanning spectrometer system has been completed for use in analyzing the alumina cloud emissivity. Author

N64-18361 Union Carbide Research Inst., Tarrytown, N.Y.
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES Quarterly Progress Report, 1 Jan.-31 Mar. 1964
Robert Lowrie 31 Mar. 1964 86 p refs
(Contract DA-30-069-ORD-2787; ARPA Order 34-63)
(AD-434588)

The computer program for the calculation of diffusion-controlled reaction rates was improved, and used to compute the diffusion-controlled rates expected for several reactions under the conditions employed in the arc-image reactor. An analytical treatment of the gas flow in stagnation-flow reactors was undertaken. The region of flow is divided into two parts—the free-stream (exterior) and boundary-layer (interior) regions. A solution for the exterior problem is presented. Stagnation pressures measured in the stagnation-flow reactor agree well with the analytical predictions. In experiments carried out with the high-pressure gas burner as a source of hot gas in a stagnation-flow geometry, tungsten-sample temperatures approaching 3,000° were attained with an O_2-rich CO-O_2 flame. The arc-image reactor and its accessories were redesigned to give greater reproducibility, higher gas-flow rates, and more precise pressure measurements. Mass spectrometric measurements of the temperature dependencies of the products of the O_2-W reaction at low O_2 pressures agree with earlier results for W_3O_9, W_2O_6,WO_3, and WO_2. The thermal expansion was measured for HfB_2 from room temperature to 2,041° C. Work is reported on the production of pure, homogeneous, solid solutions between carbides. Experiments established that TaC and NbC bodies of controlled porosity and good purity can be infiltrated with Ni, Ag, Cu, Pt, Sn, Rh, Pd, and Nichrome. R.T.K.

N64-18365 Frankford Arsenal, Philadelphia, Pa.
A BASIC INVESTIGATION OF CONTROLLABLE THRUST DEVICES FOR ESCAPE FROM ADVANCED FLIGHT VEHICLES. PHASE II: PART I – OPERATION UP TO 400 MILES; PART 2 – COMPUTER STUDY AND EXPERIMENTAL PROGRAM
Charles W. Boaz Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1964 92 p refs
(Contract AF 33(616)-59-14; Contract AF 33(616)-60-17; Contract AF 33(616)-61-12)
(FA-R-1672; RTD-TDR-63-4072; AD-434289)

The use of controllable thrust devices for escape from advanced flight vehicles was investigated. Repetitive start-stop-start operations and control of thrust rate and direction were considered for gaseous, liquid, solid, and mechanical systems with respect to problems of operating in environments up to 400 miles. Tests were conducted at standard conditions to evaluate two design ideas for thrust control. First, firings were made on a gas-buffered thruster in conjunction with a computer study. Results indicated that placement of the gas bypass ports with respect to the thrust-to-buffer area ratios in this specific design were critical for successful operation. The use of propellent gases for buffering eliminates the need for storing liquids or other buffering materials. The second design, a multiple stroke thruster, illustrated the feasibility of using a single device to accomplish a number of desired operations, thereby reducing costs, increasing payloads or space for other equipment. Author

N64-18487 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (W. Germany) Inst. für Luftstrahlantriebe
ANALYSIS AND RANGE OF APPLICATION OF THE BY-PASS ENGINE [ANALYSE UND ANWENDUNGSBEREICH DES ZWEIKREISTRIEBWERKS]
Günther Feliner Dec. 1963 213 p refs In GERMAN
(DVL-270) Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

An analysis of the bypass engine (ZTL) is conducted, the results of which are summarized in 16 theorems on this class of powerplant. The influences of all parameters determining the effectiveness of the bypass engine are investigated, and their corresponding optimum values are determined. It is pointed out that the combustion chamber temperature and bypass ratio always have to exceed certain minimum values and may not come up to certain maximum values, and that beyond an exactly definable flight speed where these maximum and minimum values coincide the application of a bypass engine is not worthwhile. The off-design performance (characteristics of thrust and specific fuel consumption) of the bypass engine is discussed. The chances of mixing both streams and of reheating are indicated. Author

N64-18509 California U., Livermore Lawrence Radiation Lab.
THE VORTEX GAS ACCELERATOR
Sterling A. Colgate 10 Feb. 1964 22 p refs
(Contract W-7405-ENG-48)
(UCRL-7377)

It is shown that the exhaust velocity of a propellant gas from an isothermal cavity can be increased by a factor of approximately 1.7 above that corresponding to the usual isentropic expansion by utilizing multiple reheat by blackbody radiation from the walls during expansion. In order to reduce the necessary volume and the frictional drag with the walls during this reheat and expansion process, the gas is wrapped up in a rotational flow pattern in which angular momentum per unit mass is constant along all stream lines. As a consequence, the expansion in the nozzle corresponds to the conversion of rotational to linear momentum, rather than the usual thermal to linear. In order to absorb the radiant energy from the walls, the gas must have a sufficient optical opacity (achieved by a small contaminant addition to hydrogen) such that the gas in the cavity is approximately one radiation mean free path thick. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see* 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-17889* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
SOLAR PROTON MANUAL
Frank B. Mc Donald, ed. Washington, NASA, Dec. 1963 122 p refs
(NASA TR R-169) OTS: $2.75

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3 ANISOTROPIES IN COSMIC RADIATION OF SOLAR ORIGIN K. G. Mc Cracken (Southwest Center for Advanced Studies) p 57-82 refs (See N64-17892 10-28)

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N64-17890* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SUMMARY OF SOLAR COSMIC RAY EVENTS

Harriet H. Malitson and William R. Webber (Minn. U.) *In its* Solar Proton Manual Dec. 1963 p 1-17 refs (See N64-17889 10-28) OTS: $2.75

Among the general characteristics of the solar cosmic-ray events considered are the intensity-time profile and the anisotropies, energy spectrum, and charge composition of the flare particles. The relationship between cosmic-ray production and the general characteristics of solar flares is also considered. The active regions at the photosphere, chromosphere, and corona levels of the solar atmosphere are discussed, and the growth of an active region is described. A discussion of possible occurrences at the earth, following a flare, includes sudden ionospheric disturbance, radio emission, ground-level cosmic-ray increase, polar-cap-absorption event, and geomagnetic storm. The specific features of important solar cosmic-ray events and related solar flares recorded from 1956 to 1961 are tabulated and discussed. Yearly integrated intensities of solar particles above 30 and 100 Mev are shown to be comparable to the total integrated intensity of galactic particles, so that with reasonable shielding of 3 to 4 gm/cm^2, only the radiation associated with the few largest events would present a hazard. The frequency of these large events and their relationship to solar activity are discussed. M.P.G.

N64-17891* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DETAILS OF INDIVIDUAL SOLAR PARTICLE EVENTS

Carl E. Fichtel, Donald E. Guss, and K. W. Ogilvie *In its* Solar Proton Manual Dec. 1963 p 19-55 refs (See N64-17889 10-28) OTS: $2.75

A time history of the intensities and energies of solar cosmic-ray particles, as detected at or near the earth, is presented, beginning with 1956. The various detectors used to study the solar particles are described, followed by a chronological discussion of the individual events, with emphasis on the interesting features and the variety of associated geophysical effects. The description of each event includes diagrams that give the integral flux as a function of time above the specified energies and the energy spectra at various times during the event. Finally, an event is hypothesized that would be just large enough to include the maximum value that has ever been recorded for each parameter for any event. M.P.G.

N64-17892* Southwest Center for Advanced Studies, Dallas, Tex.

ANISOTROPIES IN COSMIC RADIATION OF SOLAR ORIGIN

Kenneth G. Mc Cracken (Tasmania U.) *In* NASA. Goddard Space Flight Center. Solar Proton Manual Dec. 1963 p 57-82 refs (See N64-17889 10-28) OTS: $2.75

Anisotropies in solar cosmic-ray fluxes are considered in order to assist in developing criteria for space vehicle and shielding design. The nomenclature and the experimental techniques used to investigate flux anisotropies are presented. The anisotropies associated with the flares of 4 May, 12 November, and 15 November, 1960 are discussed in detail. A model for the magnetic fields within the solar system is presented; it is in good agreement with all experimental data pertaining to the cosmic-ray effects of solar flares. This model is used to predict the flux anisotropies that would be observed at low particle energies and at points far distant from the earth. Finally, a method by which the anisotropies in the solar cosmic radiation can be inferred from ground-level observations is described in order to facilitate future investigations of flare effects. M.P.G.

N64-17893* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOLAR ACTIVE REGIONS ASSOCIATED WITH SOME INDIVIDUAL EVENTS

Harriet H. Malitson *In its* Solar Proton Manual Dec. 1963 p 89-107 refs (See N64-17889 10-28) OTS: $2.75

Optical observations of the solar active regions associated with some individual events are presented in detail. M.P.G.

N64-17894* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TABLE OF SOLAR PROTON EVENTS

Harriet H. Malitson *In its* Solar Proton Manual Dec. 1963 p 109-117 refs (See N64-17889 10-28) OTS: $2.75

Solar proton events from 1949 to the present are tabulated. The following data are included: date of occurrence, earliest reported beginning time, duration in days, maximum absorption, information source, associated ground-level event, flare data, beginning times for Type IV radio bursts, and beginning times for geomagnetic storms thought to be associated with the flare. M.P.G.

N64-18000 International Geophysical Year World Data Center A, Boulder, Colo.

McMATH-HULBERT OBSERVATORY WORKING LIST OF FLARES AND DAILY FLARE INDEX FOR 1962

Helen W. Dodson and E. Ruth Hedeman (McMath-Hulbert Obs.) 1 Apr. 1964 45 p refs

(IGY Solar Act. Rept. Ser.-25)

Flare and index-area data are presented in four tables and four graphs. An appendix provides a chronological list of all flares during 1962, for which at least one observer reported the importance to be ≥ 1. A second appendix gives, for each day of 1962, the number of flares in each importance category and the flare index area. E.W.

N64-18021 Geo-Science, Inc., Alamogordo, N. Mex.

SOLAR RESEARCH AND DEVELOPMENT ACTIVITIES AT SACRAMENTO PEAK OBSERVATORY Final Report [1 Jan. 1961-31 Dec. 1963]

John Waddell III et al Jan. 1964 23 p refs

(Contract AF 19(604)-7993)

(AFCRL-64-51; AD-433974)

The research work included studies of the spectra of various solar gaseous materials and investigations of observed peculiarities. An intensified effort was begun on the problem of predicting solar flares successfully near the maximum of a sunspot cycle. Research in the instrumentation development program included the testing and modification of new instruments to integrate them into existing systems and to meet the requirements of the observing programs, the mechanization of the observatories for maximum efficiency with automatic controls, remote controls, and alarm systems. Author

N64-18124 High Altitude Observatory, Boulder, Colo.
REPORT OF SOLAR DATA IN ASSOCIATION WITH THE SOLAR ECLIPSE OF 20 JULY 1963
Dorothy E. Trotter 27 Dec. 1963 37 p
(HAO-59)

Coronal emission spectra and scans of the electron corona were obtained at the Climax station. Photographs of the total eclipse were made at a number of stations in Alaska and Canada. Some of those made at Talkeetna and Sourdough, Alaska, are included in this report. The Sacramento Peak Observatory at Sunspot, New Mexico, observed the disk in H-α. In Boulder, spectral observations of the radio sun were made in the 7.6-to-41-mc range, but no activity of any kind occurred from 17–24 July. Author

N64-18158* University Corp. for Atmospheric Research, Boulder, Colo.
THE STRUCTURE OF THE SOLAR CHROMOSPHERE. I. A PICTURE BASED ON EXTREME ULTRAVIOLET, MILLIMETER, AND λ 10830 DATA
Harold Zirin and R. D. Dietz (Colo. U.) Repr. from Astrophys. J., v. 138, no. 3, 1 Oct. 1963 p 664–679 refs
(NASA Grant NsG-90-60)

The stringent limits placed on a chromospheric model by optical, radio, infrared, and ultraviolet data are considered. These observations appear to favor a picture in which (1) the chromospheric density falls off rapidly to coronal values by 1,500 to 2,000 km, at which height the temperature has risen to 7,000° K, before a very sharp transition to coronal temperatures takes place, and (2) all the high-excitation emission, including all the helium lines, arises in spicules. In between the spicules is the corona. The optical observations of the flash spectrum show that low-excitation lines fall off very sharply with height, whereas helium and hydrogen lines show a much lower gradient. The extreme ultraviolet spectrum is discussed in detail. Author

N64-18262 Harvard Coll. Observatory, Cambridge, Mass.
CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19—1960 Scientific Report No. 26
Donald H. Menzel and F. Shirley Jones Feb. 1964 32 p refs
(Contract AF 19(604)-4962)
(AFCRL-64-93; AD-434153)

The observations used in this research consist of the complete set of prominence surveys made at the Sacramento Peak Observatory, Sunspot, New Mexico, during 1960. Instrumental difficulties in January, February, March, and most of April, and again in October, November, and December prevented observations in these months. As a consequence, the average numbers of prominence units obtained are significant for the middle third of the year only. Table I contains the measures of position and area, the intensity estimates, and the classification according to the Menzel and Evans scheme (1953) modified by the addition of classes ASa (rain) and ANe (suspended clouds). Table II lists the classifications assigned the prominences in the motion picture films made the same year at the same observatory. The columns show date, position angle of the center of the frame, classification, and additional comments. Author

N64-18263 Harvard Coll. Observatory, Cambridge, Mass.
CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19—1961 Scientific Report No. 28
Donald H. Menzel and F. Shirley Jones Feb. 1964 28 p refs
(Contract AF 19(604)-4962)
(AFCRL-64-119; AD-434154)

The observations used in this research were the complete set of prominence surveys made at the Sacramento Peak Observatory, Sunspot, New Mexico, in 1961. As in 1960, instrumental difficulties contributed to incompleteness in the coverage of the prominence phenomena. Table I contains the measures of position and area, the intensity estimates, and the classification according to the Menzel and Evans scheme (1953) modified by the addition of classes ASa (rain) and ANe (suspended clouds). Table II lists the classifications assigned the prominences in the motion picture films made the same year at the same observatory. The columns show data, position angle of the center of the frame, classification, and additional comments. Author

N64-18280* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
DYNAMICAL PROPERTIES OF STELLAR CORONAS AND STELLAR WINDS. II: INTEGRATION OF THE HEAT-FLOW EQUATION
E. N. Parker Repr. from Astrophys. J. v. 139, no. 1, 1 Jan. 1964 p 93–122 refs Previously published as NASA CR-50463; see N63-18373 17-05
(NASA Grant NsG-96-60)

The temperature $T(r)$ in a stellar corona is computed under the circumstances that energy is supplied outward from the base of the corona only by thermal conduction. The heat-flow equation is solved analytically under a variety of circumstances. It is shown that the energy flow to infinity is nonvanishing for finite coronal density and thermal conductivity. The temperature declines less rapidly than $1/r$, and a supersonic stellar wind is the only available solution of the equations compatible with negligible pressure at $r = \infty$. A variety of asymptotic cases are worked out to illustrate some of the temperature profiles $T(r)$ to be expected under various circumstances. It is shown that any effect that tends to reduce the thermal conductivity of the coronal gases at a large distance from the star has the effect of enhancing the velocity of the stellar wind. Application of the solutions of the heat-flow equation to the sun—assuming that the solar corona is heated solely by thermal conduction—shows that at least under present conditions the solar corona and wind lie in the middle ground between high and low density and temperature. Author

N64-18402 Harvard Coll. Observatory, Cambridge, Mass.
THE BRIGHTNESS OF THE SKY IN THE VICINITY OF THE SUN Scientific Report No. 19
D. H. Menzel and H. K. Sen Mar. 1963 13 p refs
(Contract AF 19(604)-4962)
(AFCRL-63-240; AD-403103)

The scattering of small particles in the earth's atmosphere, with respect to the problem of atmospheric pollution by dust, smoke, or other particles, is discussed. The study investigates the diffusion of particles from a source of pollution, such as an industrial chimney, and sets limits for the pollution in terms of sky brightness immediately surrounding the sun. P.V.E.

N64-18418* Iowa State U., Iowa City
THE EDGE OF THE POLAR PLATEAU FOR GALACTIC COSMIC RAYS AND THEIR CHARGED ALBEDO
J. A. Van Allen and W. C. Lin Repr. from J. Geophys. Res., v. 69, no. 3, 1 Feb. 1964 p 531–534 refs
(NASA Grant NsG-233-62; Contract Nonr-93803)

Lin *et al* have reported the edge of the cosmic-ray plateau as being along the contour of the magnetic shell parameter $L = 2.9$. Their data were based on information from Explorer VII. The data of Seward and Kornblum, based on information from the Air Force satellite flight 31 in September 1961, were

analyzed and were found to indicate the following: (1) The Explorer VII value of L = 2.9, representing the edge of both northern and southern polar plateau, is confirmed and is shown to be applicable to the complete range of longitude in both hemispheres. (2) The validity of L as a latitude parameter for particles arriving from infinity was exhibited. (3) The position of the edges of the plateau in September 1961 did not differ significantly from the average position during the period October 1959 to February 1961. R.T.K.

N64-18432* Massachusetts Inst. of Tech., Cambridge Lab. for Nuclear Science
COSMIC GAMMA RAY RESULTS FROM EXPLORER XI
W. L. Kraushaar, G. W. Clark, M. Agagino, G. Garmire, H. Helmken et al [1963] 8 p refs
(NASA Grant NsG-386)
(NASA CR-53590) OTS: $1.10 ph

The apparent intensity of gamma radiation as function of θ, the angle to the center of the earth, is shown graphically. From the graph it is seen that the earth, particularly the horizon of the earth, is a strong source of the radiation. The data indicate an intensity associated with the earth out to an angle of $\theta = 120°$. Beyond $\theta = 120°$, the intensity is apparently uniform. The data indicate no statistically significant celestial anisotropy. In deducing the approximate nature of the gamma-ray emission from the earth, it was found that the data fit, reasonably well, a model in which the disc of the earth emits gamma rays with an intensity $J = 3.2 \times 10^{-3}$ cm^{-2} sec^{-1} sterad^{-1}, and the total flux from the horizon is $F = 2.1 \times 10^{-2}$ cm^{-2}. P.V.E.

N64-18433* Massachusetts Inst. of Tech., Cambridge Lab. for Nuclear Science
COSMIC RAY EQUILIBRIUM
W. L. Kraushaar [1964] 4 p
(NASA Grant MsG-386)
(NASA CR-53589) OTS: $1.10 ph

A model for the proton-emission portion of the cosmic-ray spectrum is discussed, along with the electron-emission component that arises via meson decay from proton-interstellar gas collisions. P.V.E.

N64-18437* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
THE LOCAL TIME DEPENDENCE OF THE NON-STORMER CUT-OFF FOR 1.5 MeV PROTONS IN THE QUIET GEOMAGNETIC FIELD
Edward C. Stone (Ph.D. Thesis) Feb. 1964 49 p refs Submitted for Publication
(NASA Grant NsG-179-61; Contract AF 49(638)-1008; AF AFOSR Grant-62-23)
(NASA CR-53584; EFINS-64-14) OTS: $4.60 ph

Two solid-state detector telescopes, vertically and horizontally oriented, were launched into a polar orbit during a time of low geomagnetic activity. A small flux of 1.5 Mev protons, interacting with the geomagnetic field as individual particles, was observed at all latitudes above a characteristic cutoff latitude. The observed vertical cutoff was 65° on the night side and 67° on the day side, as compared to a theoretical Stormer cutoff of 76°. The local time dependence was also apparent in the cutoff transition width characterized by the difference in the latitude at which the flux is first detectable and the latitude at which the maximum (plateau) flux is first observed. On the night side the transition width was ~ 1°; on the day side the transition was ~ 3° and variable. The horizontal cutoff latitudes were similar. Essentially identical results were obtained over North and South Poles. Author

N64-18462 Instituto Geofisico del Peru, Huancayo
PART I: SPECTROPHOTOMETRIC OBSERVATIONS OF SOLAR FLARES. PART II: RESULTS FROM THE VISUAL OBSERVATION OF SOLAR ACTIVITY Final Progress Report
Mutsumi Ishitsuka Jul. 1963 38 p
(Contract AF 49(638)-637)
(AD-433788)

The instrumentation and the resulting observations obtained from the spectrophotometric observations of solar flares are described. The results of the visual observation of the solar activity are reported as follows: sunspot observation, visual patrol observation of surges (active prominence and active filament regions), statistical results of visual flare patrol observations, and statistical study of the center-limb effect of the flare area. R.T.K.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-17898 Aerospace Corp., El Segundo, Calif.
COMPARISON OF IMPULSIVE PROPULSION REQUIREMENTS FOR NONPLANAR ORBITAL CHANGE WITH CONTINUOUS PROPULSION WITH OR WITHOUT AUXILIARY AERODYNAMIC FORCES
H. Nakayama 3 Feb 1964 60 p
(Contract AF 04(695)-269)
(SSD-TDR-63-366; TDR-269(4560-30)-1; AD-433051)

An investigation was made of the propulsion system requirements for a circular orbital plane change of a vehicle with or without auxiliary aerodynamic forces. A transfer with constant velocity along a minor circle shows thrust acceleration reduction when auxiliary aerodynamic forces are not used and propellant consumption reduction when auxiliary aerodynamic forces are used. Author

N64-18007 Martin Co., Baltimore, Md.
IN-ORBIT CROSS-RANGE MANEUVERS
F. Kalil 19 Mar. 1963 38 p refs
(ER-12929)

The problem of in-orbit maneuvers was studied to determine the most efficient manner of obtaining cross range perpendicular to the orbit plane, because the calldown frequency is directly related to this cross range. Since any thrust vector can be separated into two components—one in the orbit plane and the other normal to the orbit plane—the effectiveness of each component was studied independently to simplify the problem. This report contains parametric studies of: (1) calldown frequency as a function of cross-range maneuverability; (2) cross range obtainable with in-orbit maneuvers; and (3) several sample calculations for comparing the various in-orbit maneuvers. Author

N64-18027 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
ORBIT DETERMINATION BY ANGULAR MEASUREMENTS
P. O. Bell 29 Jan. 1964 26 p ref
(Contract AF 04(695)-269)
(SSD-TDR-63-259; TDR-269(4550-10)-3; AD-431842)

From a tracking station of known geocentric location, the measurements of the azimuth and elevation of a satellite at three instants of time t_1, t_2, t_3 provide tracking data sufficient for a preliminary determination of the orbit of the satellite about the earth. From such data, the components (in a geocentered inertial coordinate system) of the position vectors $\bar{r}_1$, $\bar{r}_2$, $\bar{r}_3$ (corresponding to t_1, t_2, t_3) of the satellite may be calculated, and in terms of these components, all of the orbital elements may be expressed. In view of the given positional data of the tracking station and the directional data of the satellite's position, only the slant ranges ρ_1, ρ_2, ρ_3 are needed to complete the determination of the vectors $\bar{r}_1$, $\bar{r}_2$, $\bar{r}_3$. To solve for the slant ranges, an iterative procedure is introduced whereby successive systems of linear equations are solved whose solutions rapidly converge to ρ_1, ρ_2, ρ_3. Subsequently, all of the orbital elements are easily computed. Author

N64-18028 Aerospace Corp., El Segundo, Calif.
EARTH COVERAGE BY SATELLITE CONFIGURATIONS
Lawrence Norwood Feb. 1964 37 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-20; TDR-269(4304)-7; AD-433606)

The fundamental equations of orbital mechanics are stated, from which interrelationships among satellite altitude, speed, period, kinetic energy, potential energy, and field of view are derived analytically and depicted graphically. Attention is focused upon the Northern Hemisphere, and equations are derived that express the percentage of time that a satellite will view simultaneously all points north of a given latitude. Grazing incidence is assumed for mathematical convenience. Conclusions are drawn regarding the number of satellites required, as a function of altitude, to insure complete coverage of a polar cap or specific portion thereof, by one, two, or three orbital planes. Some consideration is given to orbital stability. It is demonstrated that the coverage afforded by elliptical orbits at critical inclination is superior to that provided by circular polar orbits. Author

N64-18078* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LOW-THRUST ORBIT RAISING IN CONTINUOUS SUNLIGHT
Dennis W. Brown Washington, NASA, Apr. 1964 37 p refs
(NASA TN D-2072) OTS: $1.00

The altitude to which an earth satellite can be raised and remain in continuous sunlight has been computed by an optimization of the initial orbit parameters and by a utilization of the oblateness of the earth as the orbital plane rotation mechanism. Altitude raising is accomplished by a continuous tangential or circumferential thrust acceleration for thrust-weight ratios between 0.75×10^{-5} and 2.00×10^{-5}. The computed missions start from circular orbits at an altitude of 300 or 500 nmi. Launch variable tolerances are discussed, and tables listing the optimum results are presented together with the methods of solution. Author

N64-18085 Autonetics, Downey, Calif.
EFFECT OF PHYSICAL CONSTANT UNCERTAINTIES UPON LUNAR ORBIT DETERMINATION
Thomas L. Gunckel 1963 31 p refs Presented at the Berlin Air and Space Navigation Congr., 20-27 Apr. 1963

A discussion of orbit-determination errors is presented for a vehicle in a near-circular lunar orbit, assuming an onboard navigation system with either a radar or a horizon scanner as the primary sensor. Such sensors depend upon a direct observation of the lunar surface; therefore, their accuracy is critically dependent upon a knowledge of the general shape of the moon. Also, any uncertainty in the lunar gravitational field will cause orbit-determination errors that are generally larger than the errors inherent in the sensors. Estimates of the uncertainty in the lunar physical constants show that the primary error sources are associated with the lunar mass, the mean size of the moon, the location of the center of mass with respect to the mean lunar surface, and the effects of local variations of altitude and slope of the lunar surface. Curves and equations are presented for estimating the orbit-determination errors as a function of time in orbit, size of sensor errors, and physical-constant uncertainties. At present, an orbit-determination accuracy of about 2 km is possible, but when the uncertainties in the lunar physical constants are reduced by further studies, an accuracy of about 0.3 km or better should be possible. M.P.G.

N64-18165* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE THERMAL ENVIRONMENT OF THE TERRESTRIAL PLANETS (SUPPLEMENT 3)
Klaus Schocken 2 Mar. 1964 34 p refs
(NASA TM X-53016) OTS: $3.60 ph

As determined by the microwave radiometer, the surface temperature of Venus averages approximately 427°C on both light and dark sides of the planet. The surface pressure is estimated as equal to about 20 bars. A new density model of the upper atmosphere of the Earth from 200 to 800 km is presented. Some physical parameters of the Moon, which are generally those of average silicate rock, are summarized. If it is assumed that the solar wind has remained unchanged over the period of the Moon's existence, then the Moon has lost a layer approximately 17 cm thick in $4.5 \cdot 10^9$ years. A series of model atmospheres for Mars has been developed in order to derive upper and lower probable limits for the variation of pressure and density in the upper atmosphere. On the assumption that ordinary meteoritic densities are of the order of 5 g cm^{-3}, mean space densities of meteoritic material at the Earth's distance from the Sun are found to be of the order of 10^{-21} to 10^{-23} g cm^{-3}. Author

N64-18170* Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
ANALYTIC SOLUTION OF THE EQUATIONS OF MOTION OF AN INTERPLANETARY SPACE VEHICLE IN THE MIDCOURSE PHASE OF ITS FLIGHT
Robert G. Stern Nov. 1963 53 p refs Presented at the 14th Cong. of the Intern. Astronaut. Federation, Paris, 27 Sep. 1963
(NASA Grant NsG-254-62)
(NASA CR-53469; RE-4) OTS: $5.60 ph

Linear perturbation theory is used to define the actual path of the vehicle relative to the elliptical reference path. The equations of motion for the actual path constitute a sixth-order linear system with variable coefficients. Two methods are presented for solving this system analytically to yield the variations in position and velocity as a continuous function of time. The first solution exploits the fact that variations in the reference trajectory plane are uncoupled from variations normal to the plane. Thus, by the choice of a coordinate system in which one of the three orthogonal axes is perpendicular to the reference trajectory plane, the sixth-order system is separated into two independent systems, one of fourth order and one of second order. The second method of solution utilizes the fact that the actual trajectory, like the reference trajectory, is an ellipse, but the orbital elements of the two ellipses are not identical. Linear theory is used to determine variations in position and velocity as a function of variations in the six orbital elements. Author

N64-18227* Sperry Gyroscope Co., Great Neck, N.Y.
TRANSFORMATION OF PLANETARY COORDINATES, PHASE I
J. F. Bellantoni *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 4–36 refs (See N64-18226 10-01) OTS: $11.00 ph

The coordinate transformations, which have been or will be included in MINIVAR, are defined. These transformations have been taken from the astronomical literature, and their primary purpose is to reduce positions and velocities specified in moving coordinate systems to corresponding quantities in an inertial coordinate system. The inertial system is specified by the mean equator and equinox obtaining at 0^h-0 January 1 of the year subsequent to the year in which the trajectory of interest takes place. Astronomical ephemerides used in the program are referenced to this base date system, and all trajectory computation takes place in this system. In addition to position and velocity transformations, provision has been made for transforming the earth's gravitational forces field into the same inertial frame. Author

N64-18228* Sperry Gyroscope Co., Great Neck, N.Y.
COORDINATE TRANSFORMATIONS, PHASE II
C. I. Smith *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 37–55 refs (See N64-18226 10-01) OTS: $11.00 ph

The precession matrix A is given. This matrix transforms from a coordinate system defined by the mean equator and equinox of date to a coordinate system defined by the mean equator and equinox of base date. Approximate formulations for the elements of A have been programed in single precision. For this phase, a double-precision program for these approximations is being written. To test the accuracy of the approximate formulation, the exact equations will be written in double precision, and a comparison will be made with the double-precision approximations. The nutation matrix N is also considered. The amount of computation required to obtain the increased accuracy, using this matrix, was found to be quite large. R.T.K.

N64-18232* Sperry Gyroscope Co., Great Neck, N.Y.
SIMULATION OF ATMOSPHERIC DRAG
D. Epstein *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 72–87 refs (See N64-18226 10-01) OTS: $11.00 ph

In order to accurately simulate the trajectory of an artificial satellite or space probe, the deceleration from atmospheric drag must be considered. In addition to the Earth, there is evidence that Mars, Venus, and Jupiter have sufficiently dense atmospheres to affect the motion of a space vehicle. Some problems involved in simulating planetary atmospheres, as well as the results of making certain simplifying assumptions, are discussed. Recommendations are made for storing atmospheric models for Earth, Venus, Mars, and Jupiter. Interpolation procedures are suggested, and, for the lower and upper Earth atmosphere models, characteristics for a transition region are recommended in order to overcome discontinuities in both the models and the applicable drag equations. R.T.K.

N64-18235* Sperry Gyroscope Co., Great Neck, N.Y.
THE RECTIFICATION PROCESS
N. F. Toda *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 103–107 (See N64-18226 10-01) OTS: $11.00 ph

This analysis of the rectification process is concerned with the observation of accuracy in the computation of the osculating orbit. The problem of accurately representing two-body motion is investigated. Particular attention is given to a universal representation applicable to all conics. A two-body representation in terms of range angle or differential true anomaly is described. R.T.K.

N64-18239* Sperry Gyroscope Co., Great Neck, N.Y.
THE OBLATENESS COEFFICIENTS
D. W. Proctor *In its* Minimum Variance Orbit Determination Program 8 Nov. 1963 p 126–130 refs (See N64-18226 10-01) OTS: $11.00 ph

The assignment of values to the second, third, and fourth harmonics of the earth's potential is discussed. A brief comparison of the oblateness terms used in ITEM, MINIVAR, JPL ROUTINES, and those based on the work of Kauala is presented. R.T.K.

N64-18258 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE WAY TO MARS
3 Jan. 1963 9 p Transl. into ENGLISH from Izv. (Moscow), 16 Dec. 1962 p 4
(FTD-TT-62-1921/1+2; AD-295767)

The interplanetary station Mars I is described. It consists of two hermetically sealed compartments--the orbital and the planetary. The orbital compartment contains the apparatus that assures the working of the station during the time of its flight to Mars; the planetary compartment contains the scientific instruments that function at the planet. Data have been received on the nature of the interplanetary medium. These data include radiation and magnetic field intensity measurements. R.T.K.

N64-18270 Autometric Corp., New York, N.Y.
GEOCENTRIC POSITION AND/OR ORBITAL PARAMETERS WITH STAR-SATELLITE PHOTOGRAPHY FROM A SINGLE CAMERA STATION
Everett Merritt 1 Nov. 1963 35 p
(Contract DA-009-AMC-178(X))
(CR-102-1; AD-432670)

This report describes the instrumentation and data-reduction procedure for the simultaneous determination of geocentric position and orbital parameters from a single camera station, with star-satellite photography referenced to time. This procedure allows an observer, at an unknown camera station, to determine both the deflection-free geocentric coordinates of the camera station and the orbital parameters of an unidentified satellite with eight or more time-referenced exposures of the unidentified satellite against a background field of stars. The general equation expressing both the geocentric coordinates of the camera station and the orbital parameters as unknowns is an 8 × 8. If the coordinates of the camera station are known, the orbit determination reduces to a 6 × 6. If, on the other hand, orbital parameters are known and the coordinates of the camera station are not, the position determination reduces to a 2 × 2. The latter two reductions become two special cases of the general 8 × 8 reduction. I.v.L.

N64-18306* Geophysics Corp. of America, Bedford, Mass.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Final Report, 2 Apr. 1963-2 Oct. 1963
F. F. Marmo Oct. 1963 186 p refs
(NASA Contract NASw-701)
(NASA CR-53559; GCA-TR-63-30-N) OTS: $13.00 ph

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1. PLANETARY AERONOMY XI: ABSOLUTE INTENSITY MEASUREMENTS IN THE VACUUM ULTRAVIOLET J. Samson 36 p refs (See N63-17316 15-07)

2. PLANETARY AERONOMY XII: THE ROLE OF INTERPLANETARY DEBRIS IN PLANETARY ATMOSPHERES I. SODIUM IN THE EARTH'S ATMOSPHERE F. Marmo and H. Brown 36 p refs (See N63-17317 15-12)

3. PLANETARY AERONOMY XIII: ELECTRON AND ION TEMPERATURES IN THE IONOSPHERE A. Dalgarno 31 p refs (See N63-17318 15-12)

4. PLANETARY AERONOMY XIV: ULTRAVIOLET ABSORPTION OF SO_2 DISSOCIATION ENERGIES OF SO_2 AND SO P. Warneck and F. Marmo 22 p refs (See N63-17320 15-07)

5. PLANETARY AERONOMY XV: TRANSPORT PROPERTIES AND SCATTERING IN MOLECULAR GASES A. Dalgarno and R. Henry 14 p refs (See N64-11295 02-23)

6. PLANETARY AERONOMY XVI: CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE A. Dalgarno 31 p refs (See N64-12097 03-28)

N64-18319 Joint Publications Research Service, Washington, D.C.

A NEW ASSAULT ON THE MOON IS COMING SOON

Nikola St. Kalitsin 3 Apr. 1964 6 p Transl. into ENGLISH from Rabotnichesko Delo (Sofia), 11 Feb. 1964 p 3 (JPRS-24009, OTS-64-21969) OTS: $0.50

A review of Soviet and American attempts to explore the moon is presented. The possibility of either country making a soft landing on the lunar surface is also discussed. R.T.K.

N64-18323* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FACTORS INFLUENCING CONFIGURATION AND PERFORMANCE OF MULTIPURPOSE MANNED ENTRY VEHICLES

Eugene S. Love Repr. from J. of Spacecraft and Rockets, v. 1, no. 1, Jan. 1964 p 3–12 refs Presented at the AIAA-NASA 2d Manned Spacecraft Meeting, Dallas, 22–24 Apr. 1963 (NASA RP-151)

The areas touched upon in this review demonstrate that the factors influencing the design of a multipurpose manned entry vehicle that is capable of entry at circular to moderately hyperbolic velocities are numerous and varied, and on occasion lead to conflicting interests. Although in some respects better definitions of future missions are needed before a well-founded recommendation can be made of the vehicle class that is best suited for multipurpose use, the results presented here, when viewed in their entirety, tend to draw attention toward vehicles having a hypersonic $(L/D)_{max}$ in the vicinity of 1. Author

N64-18324* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

MARS NONSTOP ROUND-TRIP TRAJECTORIES

Roger W. Luidens Repr. from AIAA Journal, v. 2, no. 2, Feb. 1964 p 368–370 refs
(NASA RP-154)

The following conclusions can be drawn from the present study of Mars nonstop round-trip trajectories using gravity, propulsive-gravity, and atmospheric turns at Mars: (1) When compared with gravity turns, the use of small amounts of propulsion near Mars markedly expands the range of possible trip times and, in some cases, reduces the required propulsive velocity increment. (2) The use of an atmospheric turn at Mars can reduce the required propulsive velocity increment to a value approaching that for a one-way transfer to Mars, depending on the feasible vehicle lift–drag ratios. (3) The propulsive velocity increments for the atmospheric-turn trajectories are the least affected by the launch year. (4) The propulsive-gravity and the atmospheric-turn trajectories appear to offer the potential of fast, lightweight, nonstop round trips to Mars. Author

N64-18439* Virginia U., Charlottesville Research Lab. for the Engineering Sciences

EVALUATION OF THE LUNAR PHOTOMETRIC FUNCTION Final Report

Hermon M. Parker, Thomas T. Mayo, IV, D. Scott Birney, Jr., and George Mc Closkey Jan. 1964 71 p refs
(NASA Grant NsG-468)
(NASA CR-53576, AST-4015-101-64U) OTS: $7.60 ph

A critical study of the available photometric data was conducted for the purpose of determining the accuracy with which lunar surface brightnesses may be predicted. The best published set of data for lunar maria, Fedoretz data, was used to determine the photometric function. These data plotted against brightness longitude for constant phase angle were fitted to (1) the Cornell theoretical photometric function, (2) a theoretical photometric function based on a modification of lunar models used by Bennett and Van Diggelen, and (3) empirical hand-drawn curves through the data points. The next best published set of data for lunar maria, Sytinskaya and Sharonov data, was analyzed in the same fashion. The problem of slope determination from lunar satellite observations is considered. It is shown that, if the photometric function is known, the surface slope can be determined theoretically. I.v.L.

N64-18497* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research

PACKING PROPERTIES OF FINE POWDERS AND THE DEPTH OF THE LUNAR DUST LAYER

Bruce Hapke Repr. from J. Geophys. Res., v. 69, no. 6, 15 Mar. 1964 p 1147–1151 refs
(NASA Grant NsG-382)

The results of measurements on terrestrial powders show that the packing properties of fine dust are such that a layer of rock powder of considerable depth on the moon could maintain itself in a low-density state. The measurements reported were made with rock dust being sifted in an atmosphere rather than in a vacuum. Fine powders have also been sifted from a low height in a vacuum and have been observed to have similar low-density-packing properties. The data indicate that if processes on the moon operate so as to transport fine dust from higher areas and deposit it gently in depressions, as proposed by Gold (1955, 1962), the resulting sediments could be unconsolidated to considerable depths. The density profiles of actual lunar soils would depend on the history of the soils. Extensive, deep deposits of dust on the lunar surface do not appear to be incompatible with current radiofrequency, infrared, and optical observations of the moon. At present, these observations are felt to be insufficient to permit a decision as to whether the lunar surface consists of rock foam or similar porous materials covered with a thin layer of dust, or whether deep deposits of rock powder are widespread. R.T.K.

N64-18500* New Mexico State U., University Park

MODIFICATIONS TO THE FIELD WIND WEIGHTING AND IMPACT PREDICTION PROCEDURE FOR UNGUIDED ROCKETS

Keith Hennigh Greenbelt, Md., NASA, Goddard Space Flight Center, 3 Dec. 1963 51 p refs
(NASA Contract NAS5-3318)
(NASA TM X-51579; X-671-63-270) OTS: $5.60 ph

A study of impact results of Aerobee 150A launchings at Wallops Island, Virginia, has resulted in the following changes in equations for impact prediction: (1) an additional vector required to transform the wind displacement effect from an inertial reference frame to one relative to a moving launch site on the earth; (2) the addition of one term to the wind velocity

measurements that transforms the wind velocities from a moving reference frame to an inertial frame; (3) a redefinition of the unit wind effect that makes a distinction between a "head" wind and "tail" wind relative to the tower azimuth direction; (4) replacement of the constant coriolis vector by a vector that is dependent on azimuth and range; and (5) the combining of all theodolite measurements in evaluating the ballistic wind. R.T.K.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-17897 Aerospace Corp., El Segundo, Calif.
PREDETECTION RECORDING STUDY
R. A. Hanson 25 Nov. 1963 51 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-361; TDR-269(4110-01)-15; AD-433046) OTS: $5.60

The report examines the predetection recording requirements of the Satellite Control Facility to confirm the present approach and to recommend new concepts where feasible. The four basic techniques of recording data on magnetic tape are compared, and a forecast of future requirements is made with the recommended recording technique given for each. Author

N64-17972 Joint Publications Research Service, Washington, D.C.
GUIDED BALLISTIC MISSILES AND THEIR ENGINES
G. S. Shchennikov 3 Apr. 1964 14 p Transl. into ENGLISH from Morskoy Sb. (Moscow), no. 3, Mar. 1963 p 67-74
(JPRS-24024; OTS-64-21978) OTS: $0.50

Among the topics discussed are: (1) formulas for calculating ballistic-missile trajectories; (2) the basic criteria of missile-engine efficiency—specific thrust; (3) liquid-fuel rocket motors; and (4) solid-fuel rocket motors. R.T.K.

N64-18025 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
PRESSURE MEASUREMENTS FOR MACH FIVE FLOWS OVER WINGED RE-ENTRY CONFIGURATIONS WITH AERODYNAMIC CONTROLS. PART I: BLUNT CABIN CONFIGURATION
Louis G. Kaufman Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Feb. 1964 168 p refs
(Contract AF 33(616)-8130)
(RTD-TDR-63-4179, Pt. 1; AD-433097)

Pressure data were obtained for Mach five flows over winged reentry configurations composed of cylindrical cabins mounted on a 60° sweepback delta wing with a cylindrical leading edge, clipped tips, and trailing edge flaps. The model was tested with spherical and conical fronts on the cabin, with and without tip fins, and with and without a trailing edge spoiler. Flap defections were varied from −40° to +40°, and the model was pitched at angles-of-attack from −30° to +45° for a free-stream Reynolds number, based on model length of 3,575,000. Author

N64-18040 Aerospace Corp., El Segundo, Calif. Engineering Div.
GEMINI LAUNCH VEHICLE PILOT SAFETY PROGRAM
Jan. 1963 19 p refs
(Contract AF 04(695)-169)
(TOR-169(3126)-10; AD-400476)

An outline is presented of the Gemini Launch Vehicle Pilot Safety Program. This outline is to guide all contractors and agencies supporting the Gemini Launch Vehicle Program during the implementation of specific contractual tasks. The outline covers design and development, configuration control, fabrication, acceptance, transportation, activities at the Atlantic Missile Range, and postlaunch activities (covering normal and abnormal launches). P.V.E.

N64-18112* National Aeronautics and Space Administration, Washington, D.C.
NASA SCHEDULES PROJECT FIRE LAUNCH News Release No. 64-69
1 Apr. 1964 19 p
Available from the Scientific and Technical Information Division

According to NASA, a heavily instrumented 200-pound Project FIRE spacecraft will be launched on a ballistic trajectory from Cape Kennedy, Florida, no earlier than April 6, 1964, to gather scientific information on reentry heating. The primary purpose of Project FIRE is to obtain direct measurements of reentry heating at a speed of 25,000 mph, somewhat in excess of the velocity at which a vehicle enters the earth's atmosphere after a journey to the moon. At the speed Project FIRE will attain, the temperature of the gases in the shock-wave area just ahead of the blunt reentry body will approach 20,000° F. The instrumented reentry package for Project FIRE is a blunt-faced vehicle with a conical afterbody, 26 inches in diameter across the face, 21 inches long, and with a weight of 200 pounds. P.V.E.

N64-18216* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ELECTRICAL PROPULSION REQUIREMENTS FOR PLANETARY AND INTERPLANETARY SPACECRAFT
John W. Stearns 1 Mar. 1964 13 p refs
(NASA Contract NAS7-100)
(NASA CR-53531; JPL-TR-32-403) OTS: $1.60 ph

Assumptions are made concerning the nature of scientific payloads required for planetary exploration missions and the minimum weight of spacecraft necessary to deliver a scientific payload to its destination in deep space. Although it is expected that early scientific exploration of the Moon and of Venus and Mars will be carried out most economically with chemically propelled spacecraft, it is suggested that scientific exploration of the remainder of the solar system could be accomplished most economically through the use of electrical propulsion. With relatively small variations in propellant loading, a spacecraft of single basic design could perform any one of at least seven planetary and two interplanetary scientific missions beyond Venus and Mars. This spacecraft can use a two-stage Saturn I-B as a launch vehicle. The parameters for such a mission program are discussed, and the powerplant is defined. Finally, ultimate goals for a second-generation nuclear-electric spacecraft are anticipated, and basic scheduling criteria are established. Author

N64-18302* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
SPACECRAFT ATTITUDE CONTROL FOR EXTENDED MISSIONS, VOLUME I

Noah C. New (Ph.D. Thesis) May 1963 148 p refs
(NASA Grant NsG-254-62)
(NASA CR-53556; TE-1) OTS: $11.00 ph

An interplanetary mission of 400-days duration is adopted as a general guide for the problem, but most of the equations and comparisons are presented in parametric form. Extended missions imply that a momentum-exchange attitude control system be used to minimize ejection of fuel mass, and the thesis primarily considers systems of this type. The equations of motion are derived for a spacecraft equipped with 18 different control systems. The control system chosen to best satisfy the design requirements is a system consisting of 4 gyro-type controllers arranged in 2 pairs, with each pair operating back-to-back to minimize control cross-coupling torques. One pair of controllers provides roll torques, and all 4 controllers contribute yaw torques. The stability and control analysis considers operation of the spacecraft in three modes—zero input mode, rate control mode, and position control mode. Author

N64-18303* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
SPACECRAFT ATTITUDE CONTROL FOR EXTENDED MISSIONS, VOLUME II
Noah C. New (Ph.D. Thesis) May 1963 196 p refs For abstract see N64-18302 10-30
(NASA Grant NsG-254-62)
(NASA CR-53555; TE-1) OTS: $13.50 ph

N64-18391 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ATTITUDE CONTROL: A BIBLIOGRAPHY [1958-1962]
D. W. Hill 10 Apr. 1963 66 p refs
(SID-63-232)

This report is a survey of academic literature on the attitude control of satellites and space vehicles. Only material published in English between the years 1958 and 1962 is included. Author

N64-18440* Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ORBIT POSITION CONTROL SYSTEMS COMPARISON AND SELECTION STUDY REPORT Interim Report
8 Nov. 1963 131 p
(NASA Contract NAS1-3131)
(NASA CR-53578) OTS: $10.50 ph

A system is considered in which solar flux is used as a force to change orbital parameters of a passive communication satellite in a manner that, when controlled, will permit sufficient change of these parameters to provide means for station keeping of a satellite, with respect to others in the same orbital plane. The purpose is to be able to maintain spacing of a minimum number of these satellites in order to provide maximum communications coverage around the earth's surface (as opposed to random placement of similar satellites). The method of controlling the force upon the satellite due to solar flux is to position surfaces of varying solar force characteristics toward the sun, as a function of orbital position, by torquing against the earth's magnetic field with currents in three mutually orthogonal coils rigidly fixed to the satellite. The results of the study have shown that a verically oriented system is more readily attainable than a dual flip system. Research activities were concentrated on control, structure, and orbital computations. Considered under these headings are feasibility, with regard to control accuracy and stability; structural weight; thermal balance; reliability and component life; optimum coil weight vs power-supply weight; and mobility in terms of orbital parameters. R.T.K.

N64-18456* Westinghouse Electric Corp., Baltimore, Md.
ELECTROMAGNETIC ATTITUDE CONTROL SYSTEM STUDY
Washington, NASA, Mar. 1964 167 p
(NASA Contract NAS5-1728)
(NASA CR-24) OTS: $3.00

Actuating torques for attitude-control systems in earth satellites can be produced by manipulating the currents in three vehicle-fixed coils, which react with the earth's magnetic field. Such electromagnetic actuation has been found to be feasible and to have practical application to satellite control. The technique can take the form of direct control of the vehicle momentum or of indirect control by removing momentum stored in reaction wheels. The study of electromagnetic attitude control has encompassed the analysis of both direct and indirect systems, the optimization of actuator designs, an examination of the reliability, weight, size, and power requirements of a typical system in a specific application, and the measurement of actuator effects on the detection of the earth's magnetic field. Author

N64-18457* Westinghouse Electric Corp., Baltimore, Md.
ADDENDUM REPORT ON ELECTROMAGNETIC ATTITUDE CONTROL SYSTEM STUDY
Washington, NASA, Mar. 1964 159 p refs
(NASA Contract NAS5-1728)
(NASA CR-25) OTS: $3.00

The following areas are discussed: (1) gravity gradient and electromagnetic attitude control; (2) earth's magnetic field and solar sensing; (3) ground-based control and computation; (4) solar array control; (5) further investigation of the reaction wheel and magnetic actuation combination, with application to orbits having periods of 12 and 24 hours; and (6) the constancy of the earth's magnetic field, particularly at synchronous altitude. Author

N64-18484 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
STABILIZATION AT DEPARTURE OF THE BERENICE MISSILE [STABILISATION AU DEPART DU MISSILE BERENICE]
Marcel Bismut and André Rémondière 1963 56 p Presented at the 6th Intern. Aeron. Cong., Paris Jun. 1963 In FRENCH
(*Its* T.P. No. 34 (1963))

An automatic stabilization device using auxiliary propulsion for keeping the trajectory within admissable limits was used successfully on the missile Berenice. The system design, the forces it undergoes, the law of control theory, and the problems posed by the flexibility of the missile are examined in this report. The principal results attained in flight are indicated. Trans. by E.W.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-18277 Aerospace Corp., El Segundo, Calif.
A GENERAL STRUCTURAL CRITERIA USED IN SYSTEMS RESEARCH AND PLANNING DIVISION STUDIES OF NON-RECOVERABLE BOOST VEHICLES
J. R. Henry 8 Apr. 1963 35 p refs
(Contract AF 04(695)-169)
(SSD-TDR-63-88; TDR-169(3515-60)TN-1; AD-404921)

This report contains a set of generalized structural criteria for the nonreusable boost vehicles of space launching systems and ballistic missile systems. Included are the basic objectives for the philosophy of structural design, a listing of the conditions and environments for which the vehicle must be investigated and designed, a summary of the requirements for establishing loads and other environmental factors for the design conditions, and the requirements for establishing evidence of structural adequacy. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-17907* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS I METEOROLOGICAL SATELLITE SYSTEM, PART I
Lewis J. Allison and Ernest A. Neil, eds. *In its* Tiros I Meteorol. Satellite System 1962 p 1–112 refs (See N64-17906 10-21) GPO: $2.25

The TIROS I meteorological satellite was designed to observe cloud cover over most of the earth by means of television techniques. The satellite instrumentation was remotely programed from strategically located ground stations. TIROS I was launched into a near-circular orbit, with an apogee of 465.9 statute miles, and an inclination of 48.36 degrees to the equator. The satellite traversed 1,302 orbits before the end of its 3-month functional life, and returned slightly fewer than 23,000 pictures—over 60% having high meteorological-information content. P.V.E.

N64-17908* Weather Bureau, Washington, D.C. Meteorological Satellite Lab.
INTRODUCTION TO PART II [METEOROLOGICAL PHENOMENA OBSERVED BY TIROS I AND METEOROLOGICAL SIGNIFICANCE OF THE PHOTOGRAPHED CLOUD FORMS]
Sigmund Fritz *In* NASA. Goddard Space Flight Center Tiros I Meteorol. Satellite System 1962 p 115–118 (See N64-17906 10-21) GPO: $2.25

An introduction is presented to papers dealing with the meteorological phenomena observed by TIROS I, and with exploring the cloud forms in the pictures for their meteorological significance. Among the most striking cloud patterns seen in TIROS pictures are the large-scale cyclonic vortices, whose spiral bands sometime exceed a thousand miles in diameter. The ability of TIROS to capture instantaneous patterns, to abstract the gross features and to probe the details, to reveal the cyclonic vortex, and to expose its component parts has added a new dimension to meteorological observations. The quality of the TIROS photographs is excellent; however, there have been some difficulties, mainly those in locating the picture elements geographically. Location of the clouds requires knowledge of the orientation of the satellite spin axis with respect to some frame of reference at the time the picture was taken. P.V.E.

N64-18034 Naval Ordnance Lab., White Oak, Md.
THE DESIGN AND DEVELOPMENT OF THE ARCHER SOUNDING ROCKET
H. J. Gauzza, R. H. Cornett, and R. T. Groves 14 Jun. 1963 83 p refs
(NOLTR 63-144; Aerodyn. Res. Rept. 200; AD-431784)

The Naval Ordnance Laboratory has designed, developed, and conducted free-flight tests on the Archer sounding rocket. Archer is an economical, single-stage sounding rocket capable of carrying a 25-pound payload to an altitude of 100 miles for IQSY studies. The aerodynamic and mechanical design considerations used in the production of this rocket are described. Included in the aerodynamic phase are the configuration design, the investigation of stability, and the determination of aerodynamic loads and heating. Structural integrity with minimum weight and ease of manufacture are prime considerations in the mechanical design. Archer's performance is predicted, and comparisons are made with the results of the first two test firings. Author

N64-18077* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A WIND-COMPENSATION METHOD AND RESULTS OF ITS APPLICATION TO FLIGHT TESTS OF TWELVE TRAILBLAZER ROCKET VEHICLES
Allen B. Henning, Reginald R. Lundstrom, and Jean C. Keating Washington, NASA, Apr. 1964 84 p refs
(NASA TN D-2053) OTS: $2.25

This method employs predetermined charts, obtained from either a three-degree-of-freedom or a six-degree-of-freedom trajectory analysis capable of accounting for arbitrary wind velocities, to calculate the desired launcher settings. The effectiveness of this method is shown by the results obtained from the 12 Trailblazer-vehicle launchings discussed herein. Of the results from the 12 vehicles presented herein, 17 percent of the total were on the required nominal trajectory. Eighty-three percent of the total were within 4° azimuth and 1° elevation of the nominal trajectory angles. The remaining 17 percent were within 8° of the nominal azimuth and 2° of the nominal elevation. Author

N64-18099* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NO. 5
15 Mar. 1964 12 p
(NASA TM X-51543; X-533-63-1) OTS: $1.60 ph

This report presents data that were computed and compiled by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory as of 1200Z on March 15, 1964. For each satellite, the following are presented: code name, catalog number, source, launch, nodal period, inclination, apogee, perigee, and transmitting frequency. E.K.R.

N64-18351 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
WAKE GENERATOR EVALUATION USING SOUNDING ROCKET PAYLOADS, WHITE SANDS MISSILE RANGE. ASSEMBLY AND TEST PROCEDURES (INCLUDING ORDNANCE INFORMATION AND RELATED DOCUMENTATION)
W. Astrowsky 25 Jan. 1963 59 p refs
(TDM-W-11,774, Rev. 2)

The sounding rocket payload was designed for a series of tests to determine the characteristics of wake generators. The payload consists of a dummy decoy with a timer-battery assembly and a wake generator. Documentation of the various procedures required to process the sounding rocket payload, from receipt of the payload to launch, is provided. The procedures included are: (1) assembly and test, (2) safety, (3) hold, and (4) quality assurance test. Also included is a section covering the equipment that is required for this program. P.V.E.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-17845 Forest Products Lab., Madison, Wis.
RESUME OF FATIGUE CHARACTERISTICS OF REINFORCED PLASTIC LAMINATES SUBJECTED TO AXIAL LOADING
Kenneth H. Boller. Wright-Patterson AFB, Ohio, Aeron. Systems Div., Jul. 1963. 33 p. refs
(Contract AF 33(657)-358)
(ASD-TDR-63-768; AD-430504)

This report presents a brief summary of studies made to evaluate the basic fatigue characteristics of typical reinforced plastic laminates. The majority of the evaluations were made to assay material variables, such as resins and reinforcements; however, some evaluations were made to determine effects of environments, surface conditions, and loading variables. Fatigue data between 1/4 cycle and 10 million cycles show a wide spread in strength values at the 1/4 cycle, but the spread narrows considerably at 10 million cycles. Values of fatigue strength at 10 million cycles vary from 4,000 psi for laminates reinforced with glass mat to 40,000 psi for laminates reinforced with unwoven glass fibers. Author

N64-17850 Midwest Research Inst., Kansas City, Mo.
RESEARCH ON THE MECHANISMS OF FATIGUE Technical Documentary Report, 1 Dec. 1961-31 Aug. 1963
J. C. Grosskreutz. Wright-Patterson AFB, Ohio, AF Materials Lab., Dec. 1963. 107 p. refs
(Contract AF 33(616)-7858)
(WADD-TR-60-313, Pt. 2; AD-432504)

The accumulation of fatigue "damage" has been studied on a microscopic scale in polycrystalline aluminum cycled at constant strain. At moderate strain amplitudes ($\pm 2 \times 10^{-3}$) the dominant feature is a subgrain structure that originates with the clustering of dislocations into subboundaries during the first few hundred cycles of strain. At low strains ($\pm 3 \times 10^{-4}$) large concentrations of dislocation loops are formed, either near subgrain boundaries or on glide planes in areas devoid of subgrains. At all but the very lowest strain levels, subgrains are formed in aluminum at a propagating crack tip. Crack propagation in 2024 and 7075 aluminum was observed to establish the size and nature of the plastic zone at the crack tip. The dislocation mechanism of cross-slip was investigated for its effect on the total fatigue life of Cu-Zn alloys at 100° K. The importance of surfaces to fatigue mechanisms was brought out by a study of the effect of plastic surface coatings on the fatigue of aluminum. Author

N64-17851 California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
THE BUCKLING OF CLAMPED SHALLOW SPHERICAL SHELLS UNDER UNIFORM PRESSURE
Robert Reid Parmerter. Nov. 1963. 107 p. refs
(AF AFOSR Grant 53-62)
(SM-63-53; AD-429764)

A theoretical study is carried out to determine if asymmetrical modes participate in the snap-through process. It is shown that asymmetrical buckling does occur in a certain range of a geometric parameter, at loads that are significantly less than those predicted from symmetrical theory. Additional effects can be expected if the shell has symmetrical or asymmetrical imperfections; however, the present study considers only the perfect shell. Experiments were carried out with copper shells fabricated by an electroforming process. The initial imperfections in the test specimens were of the order of 1/10 of the thickness. The buckling loads of these shells exceeded the loads that have previously been reported by as much as a factor of two at higher values of the geometrical parameter λ. Author

N64-17990* Measurement Analysis Corp., Los Angeles, Calif.
PROBABILITY FUNCTIONS FOR RANDOM RESPONSES: PREDICTION OF PEAKS, FATIGUE DAMAGE, AND CATASTROPHIC FAILURES
Julius S. Bendat. Washington, NASA, Apr. 1964. 61 p. refs
(NASA Contract NAS5-4590)
(NASA CR-33) OTS: $1.50

This report reviews a number of theoretical matters in random process theory that can be applied to physical problems, such as predicting peaks, structural fatigue damage, and catastrophic structural failures. The presentation emphasizes the basic assumptions that are involved, and discusses how to properly interpret the theoretical results. Various engineering examples are given as illustrations. Author

N64-18037 ARA, Inc., West Covina, Calif.
RESEARCH ON ENERGY ABSORBING STRUCTURES, PART II Final Scientific Report, Feb. 1963-Feb. 1964
Bernard Mazelsky. Feb. 1964. 74 p. refs
(Contract AF 49(638)-1144)
(AFOSR-64-0154; AD-432958)

Analytical methods for predicting the large-deformation behavior of corrugated cylindrical and conical shell structures are presented, and tests with simple corrugated specimens for evaluating the theoretical predictions are described. Tests on corrugated strips loaded into the plastic range for evaluating previously developed analyses are described, and correlations with theoretical predictions are shown. A novel bimetalic flexural spring damper is described. Moment-curvature tests to demonstrate the behavior are discussed, and correlations with theoretical predictions are shown. Author

N64-18066 New York U., N.Y. Courant Inst. of Mathematical Sciences
NONLINEAR BUCKLING OF RECTANGULAR PLATES
Louis Bauer and Edward L. Reiss. Dec. 1963. 48 p. refs
(Contract Nonr-285(42); Contract AT(30-1)-1480)
(IMM-NYU-316; AD-432347)

The nonlinear deflections of a thin, elastic, simply supported rectangular plate are studied. The plate is deformed by a compressive thrust applied along the short edges. For the boundary-value problem considered it is proved that the plate cannot buckle for thrusts less than or equal to the lowest eigenvalue

of the linearized buckling problem. For larger thrusts approximate solutions of the von Karman equations are obtained by an accelerated iteration method. Each iterate is numerically evaluated by a finite difference procedure. Using this method approximate solutions are obtained for thrusts considerably larger than the lowest eigenvalue. These solutions bifurcate from the eigenvalues of the linearized problem. Author

N64-18103* Wyle Labs., Inc., Huntsville, Ala. Southeast Test Div.
ACOUSTIC TESTS ON TYPICAL SATURN SHROUD STRUCTURE
D. J. Bozich 31 Oct. 1963 195 p refs
(NASA Contract NAS8-5113)
(NASA CR-53394; TM-5) OTS: $13.50 ph

The response to acoustic excitation of typical structural panels from the Saturn engine shroud has been investigated experimentally and theoretically. The experimental results of the study are presented. After obtaining the response data, the tests under broadband excitation were continued until structural failures occurred. The tests of three similar complex panel specimens arrived at a common result. All three panels failed in similar fashion and exhibited lifetimes of approximately 27 min, which were roughly 5 to 10 times the duration of anticipated lifetime requirements, including static firings, aborts, and launch. Author

N64-18113 Space Technology Labs., Inc., Redondo Beach, Calif.
THE DYNAMIC RESPONSE OF A SOLID, VISCOELASTIC SPHERE TO TRANSLATIONAL AND ROTATIONAL EXCITATION
R. M. Christensen and W. G. Gottenberg 6 Mar. 1963 28 p refs
(Rept. 6121-6358-RU000; EM13-6)

A solution is presented for the dynamic response of a solid sphere of linear viscoelastic material bonded to a mating, rigid spherical cavity that undergoes harmonic excitation. The dynamic response in the form of complex mechanical impedance is obtained in exact analytic form for two types of excitation of the rigid spherical boundary—rotation about a diameter and translation along a diameter. For the purpose of showing the usefulness of this system for experimentally determining the general stress–strain characteristics of the linear viscoelastic material, the sensitivity of the complex mechanical impedance of the sphere in each mode of excitation is examined relative to variations in the complex dynamic shear modulus and complex dynamic Poisson's ratio of the material. Author

N64-18135 Army Materials Research Agency, Watertown, Mass.
THE ROTATIONALLY SYMMETRIC MOTION OF A SMALL ANGLE TRUNCATED CONICAL SHELL DUE TO A CONSTANT VELOCITY PRESSURE FRONT, PART I: ANALYSIS
Joseph I. Bluhm Dec. 1963 37 p refs
(AMRA TR-63-28; AD-425702)

A thin truncated conical shell is analyzed for the initial transient response due to the passage of a pressure front of constant velocity and amplitude. The principle of virtual work is applied to a segment of the shell, between two adjacent generatrices, treated as a beam on an elastic foundation. The ends of the shell are considered to be simply supported. First, the natural or free modes of vibration are approximated using an eight-term series of functions, each satisfying the boundary condition. Then the resulting modes are used in conjunction with time-dependent coefficients to formulate the forced response. This report consists of the analysis and derivations pertinent to the problem. Author

N64-18168 Lehigh U., Bethlehem, Pa.
A CRITICAL ANALYSIS OF CRACK PROPAGATION LAWS
P. Paris and F. Erdogan Repr. from Trans. Am. Soc. Mech. Engrs., Ser. D, Dec. 1963 p 528–534 refs
(Sponsored by Boeing Co.)

The practice of attempting validation of crack-propagation laws with a small amount of data, such as a few single specimen test results, is questioned. It is shown that all the laws, though they are mutually contradictory, can be in agreement with the same small sample of data. It is suggested that agreement with a wide selection of data from many specimens and over many orders of magnitudes of crack-extension rates may be necessary to validate crack-propagation laws. For such a wide comparison of data a new simple empirical law is given that fits the broad trend of the data. Author

N64-18275 Oak Ridge National Lab., Tenn. Reactor Div.
AN EXPERIMENTAL INVESTIGATION OF INSTANTANEOUS-COLLAPSE AND CREEP-BUCKLING CHARACTERISTICS OF CYLINDRICAL SHELLS
B. L. Greenstreet and J. M. Corum Mar. 1964 44 p refs
(Contract W-7405-ENG-26)
(ORNL-3555) OTS: $1.00

Instantaneous-collapse and creep, or time-dependent, buckling tests were conducted on nominally 8.0-in.-OD by 0.25-in.-wall and 4.0-in.-OD by 0.12-in.-wall specimens made from commercial pipe and tubing. The material for the larger specimens was type 304 stainless steel, whereas the smaller ones were made of both type 304 and type 347 stainless steel. The length chosen in each case was infinite from the buckling standpoint. The instantaneous-collapse test temperature ranged from room temperature to 1,200° F, and all the time-dependent collapse tests were made at 1,200° F. The results show that tube out-of-roundness is a major factor in determining the collapse pressure. They also show that, under creep–collapse conditions, the critical pressure decreases rapidly with time, initially. This decrease is then followed by a leveling off, with very little change after the first few hundred hours. Author

N64-18278 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
APPLICATION OF ELECTRO-MODELLING OF CONFORMAL TRANSFORMATION TO SOLUTION OF THE TWO-DIMENSIONAL PROBLEM OF THE THEORY OF ELASTICITY OF SINGLY CONNECTED AND DOUBLY CONNECTED REGIONS [PRIMENENIE ELEKTROMODELIROVANIYA KONFORMNOGO PREOBRAZOVANIYA K RESHENIYU PLOSKOI ZADACHI TEORII UPRUGOSTI DLYA ODNOSVYAZNYKH OBLASTEI]
A. G. Ugodchikov Feb. 1964 7 p refs Transl. into ENGLISH from B. M. Novocherk. Politekhn. in-T. (USSR), 1960 p 15–18
(TIL/T.5449)

The use of this technique, its development, and some applications are described for practical engineering problems. The experimental method is not described, except that a conducting-paper analog machine is used. As an example, the stress state in a welded T-joint is calculated. Author

N64-18297* Allied Research Associates, Inc., Concord, Mass.
ELASTIC AND PLASTIC STABILITY OF GEOMETRICALLY ORTHOTROPIC SPHERICAL SHELLS
C. Lakshmikantham and George Gerard 15 Jan. 1964 8 p refs
(NASA Contract NASw-682)
(NASA CR-53354; Tech. Rept. 235-3) OTS: $1.10 ph

The uncoupled equilibrium equations for the buckling problem of a sphere under external pressure are derived, and an approximate solution for an orthotropic stiffened sphere is obtained. E.W.

N64-18298* Allied Research Associates, Inc., Concord, Mass.
ELASTIC STABILITY OF CYLINDRICAL SHELLS UNDER AXIAL AND LATERAL LOADS
C. Lakshmikantham and George Gerard. 10 Feb. 1964. 10 p. refs
(NASA Contract NASw-682)
(NASA CR-53361; Tech. Rept. 235-4) OTS: $1.10 ph

Using the Donnell equation for small deformations, the present report considers the effect of various compressive loading combinations on the stability problem of an unstiffened circular cylinder. R.T.K.

N64-18344 Gt. Brit. Ministry of Aviation, Mottingham. Technical Information and Library Services
DESIGN OF ARCH DAMS BASED ON THE THEORY OF THIN ELASTIC SHELLS [RASCHET AROCHNYKH PLOTIN PO TEORII UPRUGIKH TONKIKH OBOLOCHEK]
S. S. Kalinovskaya. Feb. 1964. 11 p. refs. Transl. into ENGLISH from Inzh. Zh. (USSR), v. 1 (2), 1961. p. 119–125
(TIL/T-5423)

A relatively simple method of design is examined. This is based on proposals by A. L. Gol'denveizer and uses the principle of dividing up, or sectioning, the stresses. The problem is reduced to a two-dimensional one and so has similar drawbacks to the Ritz method. It is a useful preliminary design method from which basic functions for the Ritz method can be chosen. Author

N64-18364 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
CIRCULAR PLATES ON ELASTIC, SEALED FOUNDATIONS
D. E. Nevel. Dec. 1963. 18 p. refs
(CRREL-118; AD-434084)

The observation that newly frozen ice sheets, resulting from pools of water freezing over, support more load than would be predicted by ordinary theory is assessed. A solution is presented for a circular plate on an elastic, sealed foundation. Graphical results are shown for supports at the circumference of the plate. Graphs to obtain moments in a circular plate on an elastic bearing surface, using a sealed or unsealed foundation, are compiled for fixed and simple supports. In reality the foundation may not be completely sealed, calling for discretion in selecting the actual moment. The ability of the refrozen ice sheet to support the extra load is explained by the fact that the water has been sealed between the surface and main sheet of ice, and the volume occupied by the water cannot change. Author

N64-18373 Columbia U., New York, N.Y.
FORCED VIBRATIONS OF A VISCO-ELASTIC CYLINDER CASE-BONDED TO A THIN ELASTIC SHELL. Technical Report No. 22
L. A. Henry and A. M. Freudenthal. Jan. 1964. 91 p. refs
(Contract Nonr-266(78))
(AD-434192)

This paper is concerned with the forced vibrations of case-bonded solid propellant grains. Special attention is paid to the interaction between the thin elastic shell (case) and the thick-walled propellant cylinder. The effects of material damping in the propellant are explored. Frequency-response functions are computed that can be used for analysis in situations where the loading is arbitrary deterministic or random (stationary). Author

N64-18393 National Aeronautical Lab., Bangalore (India)
STRESSES IN A MITRED PIPE JOINT DUE TO INTERNAL PRESSURE OR PURE BENDING
M. V. V. Murthy. May 1963. 34 p. refs
(NAL-TN-SA-4-63)

The stresses at the intersection of two long circular cylindrical pipes of equal diameter rigidly connected over a plane elliptic section to form a "mitred" joint have been analyzed by employing the basic shell theory equations. It is shown that the method can be extended to the case of pure bending due to a symmetric couple also. The results are found to agree with those of Green and Emmerson obtained from the theory of three-dimensional linear elasticity. Author

N64-18415 Oak Ridge National Lab., Tenn.
ANALYSIS OF SIMPLY SUPPORTED GRIDS OF PERPENDICULAR BEAMS
F. J. Witt. Mar. 1964. 43 p. refs
(Contract W-7405-ENG-26)
(ORNL-3535) OTS: $1.00

An analysis of a rectangular grid of perpendicular beams simply supported at the ends is presented. Bending, shearing, and torsional effects of beams with arbitrary cross sections are taken into account; the beams may be subjected to uniform or concentrated loads. An energy method is used in the analysis, and a matrix formulation for determining the unknown coefficients appearing in the Fourier series expression for the lateral deflection is given. This formulation is especially suited for computer application, and a computer program for performing the analysis is described. Data are presented for use in the design and evaluation of certain grid configurations. Applications to nonrectangular grids are also considered. Author

N64-18445* IIT Research Inst., Chicago, Ill.
EXPERIMENTAL DETERMINATION OF STRESS DISTRIBUTIONS IN THIN WALLED CYLINDRICAL AND SPHERICAL PRESSURE VESSELS WITH CIRCULAR NOZZLES. Phase Report No. 1 [7 Mar. 1962–1 Nov. 1963]
W. F. Riley. 11 Dec. 1963. 76 p
(NASA Contract NASr-65(05); IITRI Proj. M6053)
(NASA CR-53580) OTS: $7.60 ph

This report contains the complete results of a study that was conducted to determine stress distributions in thin-walled cylindrical and spherical pressure vessels with nozzles. Studies were conducted on a cylindrical vessel ($D/t = 240$) with a circular nozzle ($d/D = 0.5$) and on a spherical vessel ($D/t = 240$) with a circular nozzle ($d/D = 0.5$). Stress distributions were determined in each vessel for internal pressure, axial thrust on the nozzle, and external moment forms of loading. The results are presented in both graphical and tabular form. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

No abstracts in this issue.

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